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STORAGE

TRANSACTIONS

OF

THE ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE

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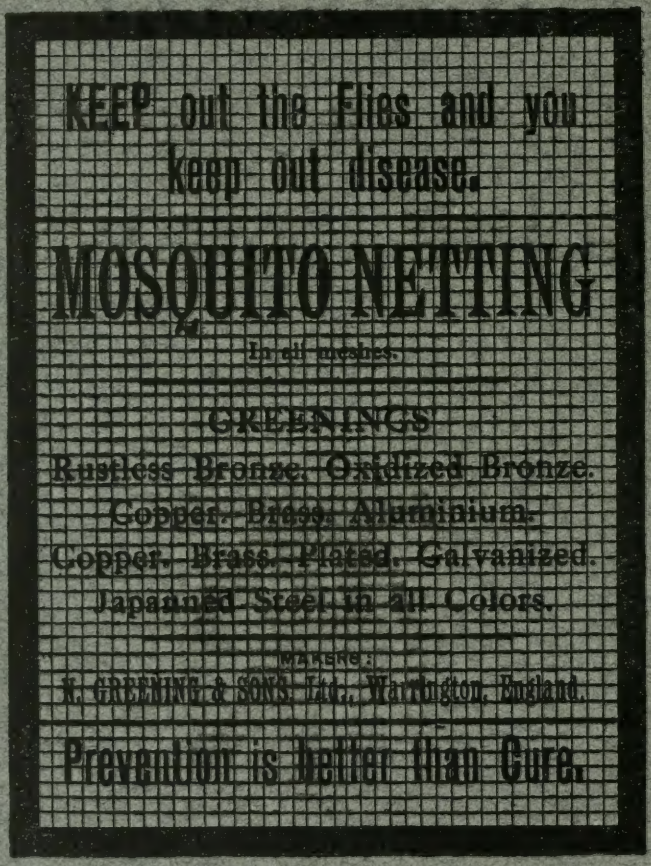
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ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE.

NOVEMBER AND DECEMBER, 1921. VOLUME XV. NOS. 5 & 6.

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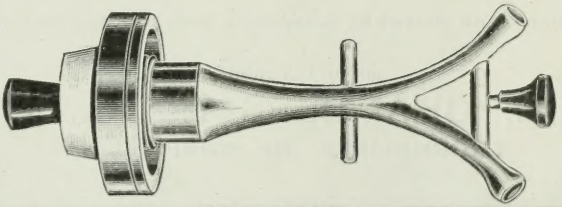

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TRANSACTIONS

OF THE

ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE.

NOVEMBER 17TH AND DECEMBER 15TH, 1921.

VOLUME XV. NOS. 5 AND 6.

Proceedings of a Laboratory Meeting of the Society held at the London School of Tropical Medicine on Thursday, 17th November, 1921, at 8.15 p.m. In the absence of the President, the Chair was taken by Sir PERCY W. BASSETT-SMITH, K.C.B., C.M.G.

LABORATORY MEETING.

The Society is indebted to the Board of Management of the Seamen's Hospital for granting them facilities for holding the Meeting at the School of Tropical Medicine.

The following demonstrations were given :—

Drs. W. BROUGHTON-ALCOCK and J. GORDON THOMSON gave the following demonstration :—

1. *Eimeria oxyspora*, DOBELL, 1919.—Oocyst with a single mass of undifferentiated cytoplasm. A small amount of oocystic residuum was present at this stage.

2. *Eimeria oxyspora*, DOBELL, 1919.—In this oocyst the contents were divided up into four sporoblastic masses, No nuclear structure was visible at this stage, but there was a considerable amount of residual material in the oocyst.

3. *Eimeria oxyspora*, DOBELL, 1919.—The four sporocysts had taken the characteristic shape and the cyst wall was formed. The sporozoites, however, were only developing, and appeared as oval bodies at either end of the sporocyst. In each sporocyst were numerous refractile bodies, but the nuclei could not be clearly made out.

4 and 5. *Eimeria oxyspora*, DOBELL, 1919. Two fully differentiated oocysts. Within the oocyst, in addition to the four sporocysts, there was a certain amount of residual material. The sporozoites were fully formed, and the nuclei could be made out in the majority of them, situated near the middle of the body, but rather near the posterior end. At the posterior ends of the sporozoites there could be made out the fusiform crystalline bodies.

6. *Embadomonas intestinalis*, WENYON and O'CONNOR, 1917.—Showed a typical flagellate form of this parasite, in which the nucleus, the two flagella, and the cystostome could be made out.

7. *Embadomonas intestinalis*, WENYON and O'CONNOR, 1917.—A typical cyst of the parasite, showing the carrot-shaped outline of the cytostome.

A series of photomicrographs and camera lucida drawings, illustrative of both the above-mentioned parasites, was also shown.

Professor R. T. LEIPER exhibited for the Department of Helminthology of the London School of Tropical Medicine a series of microscopical preparations which illustrated the tissue reactions of the host to helminth infections:—

(*a*) Cerebral sparganosis.
(*b*) Paragonimiasis.
(*c*) Clonorchiasis.
(*d*) Invasion of the bile ducts with *Ascaris lumbricoides*.

Major H. C. BROWN gave a demonstration of the results obtained in a method which, he hoped, would be useful in enriching the number of dysentery organisms in cultures from stools. He had been doing this work in conjunction with Mr. MUGGLETON, the Chief Laboratory Assistant of the Wellcome Bureau of Scientific Research, and as they had been unable to obtain cases of dysentery which were actually excreting the bacilli, they had to use saline suspension of a mixture of *B. coli* and

dysentery bacilli. The maximum enrichment obtained in such mixtures was 11·8 times that in the control plate from the same mixture.

The method of enrichment consisted in adding a small quantity of homologous high titre serum to the mixture of organisms, and then plating out from the deposit after the agglutinated bacteria had had time to settle. The result of enrichment was shown in a MacConkey plate from an actual case of paratyphoid fever, in the plate from the saline suspension of stool, treated with serum, several hundred *B. paratyphosus* B colonies were seen, whereas in the control plate made from the same saline suspension, no pathogenic organisms were present.

This method differs from that advocated by CASTELLANI, in which the bacteria which it is required to isolate are sedimented by homologous sera, and the supernatant fluid is plated out. The preparation of the various sera used in this method is a laborious procedure, and it seems much more simple to use agglutinating sera for the pathogenic organism, and plate from the deposit.

The elementary fact that agglutinated organisms are still alive and capable of growth has been made use of in the present method.

The inactivated patient's serum, in the later stages of the diseases, might also be used in this way.

Dr. P. H. MANSON-BAHR exhibited a series of microscopic sections showing the various changes which take place in the gut as the result of bacillary dysentery. In the earlier stages the infection causes intense hyperæmia of the mucosa, followed later by necrosis, a process which may very occasionally involve the submucosa and muscular coats as well. In the repair of the damaged gut, sections demonstrated exfoliation of the necrotic layers, proliferation of macrophage cells in the submucosa, and attempts at regeneration by the formation of granulation tissue. Other sections illustrated submucous cysts and secondary infection of the gut wall with tubercle.

Charts and the clinical history of a case of liver abscess, which had burst into the right lung, were also exhibited. The patient had done very well on ipecacuanha and emetine; his temperature had become normal almost immediately, and he had put on over a stone in weight. The interesting point about the case is not the exceptional nature of the condition, but the fact that the sputum contained large numbers of yeast

cells and mycelial threads. On cultivation yeasts of several varieties, as well as aspergilli, were isolated by Dr. DUNCAN. Immediately ipecacuanha was exhibited, expectoration ceased, and the yeast cells disappeared.

These yeast cells were obviously derived in this case from the abscess cavity, and were therefore to be regarded as a secondary infection, and not as a primary disease.

CASTELLANI has described cases of this nature as bronchomycosis, or bronchomoniliasis, on what appears to be very little evidence, and it is open to doubt, in view of the history of this case, whether the appearance of yeast fungi in the sputum is to be regarded as of any pathological or even diagnostic significance.

Drs. G. C. LOW and ELIZABETH O'DRISCOLL showed pathological specimens from a fatal case of blackwater fever; a supposed case of malaria which proved to be malignant endocarditis, and a series of specimens of trypanosomes from the cerebro-spinal fluid.

The blackwater fever patient had spent eighteen months in West Africa, where he suffered from slight attacks of malaria.

On the voyage home he was quite well and for the first part of his stay in London, when he suddenly developed fever with the passage of blackwater. He was taken into hospital at once and the usual treatment adopted.

On the second day the amount of urine sank to a few ounces and suppression threatened. By the use of saline intravenously, cupping the loins, etc., this was successfully combated and the amount of urine returned to normal. Though this was so, the patient did not do well; hæmorrhages began to appear from the mucous membranes—though the urine was now quite clear—and he gradually sank and died. During the progress of the case it was discovered that the blood gave a three plus Wassermann reaction. A good lot of the blood from the mouth came from an ulcer in the hard palate. The combination of the syphilitic infection raises some interesting points. Recently, many of the paroxysmal hæmoglobinurias have been shown to have strong positive Wassermann reactions, and it is possible that some of the many so-called blackwater fevers may be syphilitic in origin.

The organs of the malignant endocarditis case show what mistakes are

being made with regard to the diagnosis of malaria in people who have been abroad: the patient had been treated for three years with quinine on the supposition that he was suffering from the latter disease. The autopsy showed typical malignant endocarditis, the enlarged spleen being due to septic infarcts. Dr. DUNCAN isolated a pure staphylococcus from the lesions. There was no evidence of any malarial infection.

The specimens of trypanosomes were taken from a new case of human trypanosomiasis just arrived from Nigeria. Though apparently only five months infected, a lumbar puncture showed that the cerebro-spinal already contained trypanosomes. Nervous symptoms of an obscure nature are present. The trypanosomes from the cerebro-spinal fluid are often degenerated and show peculiar forms. A series of these were shown.

Dr. ANDREW BALFOUR showed two poisonous sea fish from Mauritius.

The two curious fish exhibited in the next room are *Synanceia brachio* var. *verrucosa* and *Pterois volitans*. I owe them to the kindness of Sir HESKETH BELL, the Governor of Mauritius. They are known locally as laffes and are a source of danger to the bare-footed fisherman or bather. You will note their dorsal spines, large in the Synanceia, small in the Pterois. These communicate with poison glands which contain a powerful venom. In the case of the Synanceia, the grooves in the spines are closed by a membrane which converts the latter into sacs. This membrane must be ruptured before the venom is discharged.

Both these fish are passively defensive. They do not attack, but when trodden upon the spines penetrate the skin, break across, and the poison is ejected.

The ensuing symptoms are violent pain, spreading up the limb, great restlessness, and, in severe and untreated cases, death may result from cardiac failure. Sometimes there is local trouble in the form of suppuration, and even sloughing, while a secondary septicæmia may develop.

It is interesting to note that the Creole fishermen possess a cure which is said to be derived from a plant growing on the sea-shore. They make a poultice of it, and its application affords speedy relief. The secret is carefully guarded by certain families, and is handed down from father to son.

It would seem that here we have an opportunity for some useful and interesting research work.

Dr. J. A. Arkwright and Mr. A. Bacot exhibited slides showing stages of Rickettsia in the sheep ked—*Melophagus ovinus*.

Rickettsia melophagi was first described by Nöller in 1917. He stated that it was constantly present in the alimentary canal of *Melophagus ovinus* and was hereditary, being passed on to successive generations of the insect. The originally described and generally recognised form of this Rickettsia is a minute dumb-bell shaped organism about 0·4 micron in diameter, which is found in very large numbers lying close to the epithelial cells of the fore and mid gut, adhering to the cilia of the epithelium, and consequently arranged in rows at right angles to the surface of the lining membrane. The same part of the gut which is inhabited by the Rickettsia usually contains also great numbers of *Crithidia melophagia* which, however, lie nearer the centre of the lumen.

During the past year we have examined a number of *M. ovinus*, and in the case of the adult insect have been able to confirm the constant occurrence of enormous numbers of the typical form of *R. melophagi* in the alimentary canal. We have also seen other forms in very large numbers, which we regard as the same organism under different conditions or in different phases of its existence. The films and sections have been stained by Giemsa. The following varieties of form have been found, and specimens were shown :—

(1) The very small form seen in masses in the fore part of the gut may be rod-shaped instead of dumb-bell shaped, though still of approximately the same size.

(2) Much larger forms, which are more in evidence in places where there are few typical Rickettsia or flagellates. They are seen especially in smears of the hind gut of the adult insect and in the alimentary canal of the embryo. These relatively large bodies vary in size from about 1 to 2·5 microns, or even more, in diameter, are round or oval in shape, and are usually deeply stained at the poles or on one side, but unstained in the centre, though some are stained throughout. These forms were at first regarded as an entirely different organism, but are in all probability *R. melophagi*.

(3) Intermediate forms between the minute and large forms are very numerous in some situations. These are short rods or oval forms, with poplar staining and clear centre. They vary very much in size and

Fig. 1.

Portion of smear of gut of an adult "ked" *after feeding.*

× 1,500.

Fig. 2

Forms observed in smear of mid and hind gut of newly emerged *unfed* "ked."

× 1,500.

Fig. 3

Forms observed in smear of mid gut of newly emerged "ked."

× 1,500.

To face page 116.

shape, and appear to provide abundant links connecting the extreme forms.

These links were first observed and are perhaps most often found in the gut of the embryo dissected out of the puparium and of the newly-emerged adult insect; in the latter, beside a very varied assortment of the large and intermediate forms, small groups of minute Rickettsia are often seen.

The variety of shapes and appearances seen has a striking likeness to that exhibited by some bacteria under different conditions, and this similarity strongly suggests the bacterial nature of *R. melophagi*.

We are indebted to Miss RHODES for the extremely accurate drawings for the accompanying plate.

Dr. P. A. MAPLESTONE exhibited a smear stained with Leishmann, from a granulomatous swelling on the inside of the right cheek of a female Australian aborigine, *æt.* about 22.

The smear showed numerous organisms in heavily-infected large mononuclear cells, and also free (extracellular).

On account of the similarity of these organisms to those described by ARAGAO and VIANNA (Mem. de Instit. Ozwaldo Cruz, Vol. V), a diagnosis of ulcerating granuloma was made; the patient was treated with intravenous injections of tartar emetic, and it cleared up rapidly.

This case is interesting, as it is very rare, if not unique, to find the condition in the mouth, the genitals being practically always the part affected.

Professor WARRINGTON YORKE and Dr. J. W. S. MACFIE showed:—

I. A specimen of urine from a case of paroxysmal hæmoglobinuria indistinguishable from that passed during an attack of blackwater fever; and also specimens of blood from the same case, showing autolysis.

The autolytic reaction is obtained as follows:—A small quantity of blood is withdrawn and immediately placed upon ice for five minutes, and then in an incubator at 37° C. for one hour. On centrifugalisation the serum is found to be red. No hæmolysis occurs if the blood be not placed on ice before putting in the incubator, as the immune body present in the hæmoglobinuric blood only unites with the red cells at low temperature. The maximum degree of hæmolysis is obtained if the

cooling be for from 5 to 7½ minutes; when the period of cooling is prolonged the degree of hæmolysis becomes less and less, until, if the cooling is prolonged for 60 minutes, the degree of hæmolysis is only about 10 per cent. of that obtained when cooling is for 5 minutes only. The explanation of this paradox is complicated and depends on complement splitting.

Tube 1.—Paroxysmal blood not cooled and put straight into incubator at 37° C. for 60 minutes. Result, no hæmolysis.

Tube 2.—Paroxysmal blood cooled for 5 minutes before putting into incubator for 60 minutes. Result, intense hæmolysis.

Tube 3.—Paroxysmal blood cooled for 1 hour before putting in incubator for 60 minutes. Result, slight hæmolysis.

N.B.—This reaction is not given by blood from blackwater fever patients.

II. Specimens illustrating the anatomy of *Oxyuris equi*, Schrank, 1788, Rudolphi, 1803, and *Enterobius vermicularis*, Linnæus, 1758, Leach, 1853.

The worms exhibit the following striking differences in their internal anatomy:—

	OXYURIS EQUI.	*ENTEROBIUS VERMICULARIS.*
Ant. extremity ...	No cuticular flange.	Cuticular flange.
Mouth opening ...	Oval; surrounded by six equal inconspicuous lips.	Triradiate; surrounded by three relatively prominent lips.
Mouth cavity ...	Large, partly chitinised and provided with three prominent teeth in the female, and with numerous chitinised bristles in both sexes; these structures project into the mouth from the œsophageal funnel.	Minute and unarmed.
Œsophagus	Relatively short. Broad, cylindrical, ant. portion. Narrow, cylindrical, med. portion. Spherical, post. portion. No posterior œsophageal bulb.	Relatively long. Almost cylindrical, narrow, and dilating slightly posteriorly. Well-marked posterior œsophageal bulb.
Female genitalia ...	Large, single, sac-like uterus.	Two divergent uteri.
Eggs	Shells thick; large plug at one pole.	Shell not so thick; without any plug.

III. A blood film of a rat showing a small spirochæte obtained by Dr. Corson from a Gold Coast dog. The organism appears to be identical with *Sp. laverani*, Breinl and Kinghorn, 1906.

Professor Blacklock and Professor Yorke showed blood films made from Sierra Leone natives containing ciliates resembling Nyctotherus. These organisms probably came from the water with which the films were washed.

Squadron-Leader H. E. Whittingham, R.A.F.M.S., gave a demonstration on a spirochæte isolated from cases of sandfly fever in Malta.

A spirochæte having morphological characters very similar to the *Leptospira icterohæmorrhagiæ* has been isolated from cases of sandfly fever occurring in Malta.

Briefly, the work was carried out in the following manner. A nominal roll of the Royal Air Force personnel at Calafrana, Malta, was prepared, showing the term of service out of England. the nature of any previous fever, and date of T.A.B. inoculation. From this roll it was easy to isolate all those who had not spent a summer overseas before. These men were inspected and had their temperature taken daily. Any who had fever were immediately admitted to sick-quarters. Those with a temperature of 99° F. were instructed to report at the laboratory a few hours later to have their temperature again recorded. In this way cases of fever were diagnosed in their early stage.

From previous work done by Birt and others, it was proved that the blood of man was infective by direct transmission to other men only on the first day of disease. Thus it was decided to limit the blood-culture work to the first day of disease.

Every case admitted to the sick-quarters was carefully gone over, and only those showing the typical symptoms of sandfly fever were accepted for the investigation. In all, twenty-six cases of apparent sandfly fever were investigated. To aid in the differential diagnosis these cases had their blood examined daily for fourteen days for malaria parasites, total and differential leucocyte counts. Venupuncture was performed in every case on the first day of the fever. The blood collected was disposed of as follows:—

2 c.c.	was inoculated into	1 c.c. of Wenyon-Noguchi medium.
5 c.c.	,,	30 c.c. ,, ,,
5 c.c.	,,	30 c.c. of nutrient broth.
3 to 5 c.c.	,,	guinea-pigs intraperitoneally in 15 cases.

The remaining blood was used to carry out the Wassermann test and agglutination test against *B. typhosus*, *B. paratyphosus* A and B, *B. enteritides*, GAERTNER, *B. dysenteriæ*, SHIGA and FLEXNER, *M. melitensis* and paramelitensis. On the 10th day of disease the blood was again collected for agglutination tests. The urine was examined daily, especially for albumen, bile and spirochætes.

Synopsis of results.

A. Blood cultures.
B. Inoculation of guinea-pigs with whole blood.
C. Inoculation of guinea-pigs with cultures of spirochætes.
D. Inoculation of man with cultures of spirochætes.
E. Blood counts.
F. Wassermann and agglutination tests.
G. Urine examination.

A. Blood Cultures.—Dark ground illumination of the primary blood cultures in the Wenyon-Noguchi medium revealed, after the 5th to 6th day of incubation at 27°C., the presence of spirochætal bodies in six cases. These spirochætes morphologically resembled leptospira. Three of these primary cultures were successfully subcultured. Unfortuately one of the subcultures was contaminated, and lost in transit from Malta to England.

B. Inoculation of guinea-pigs with whole blood.—Most of the guinea-pigs inoculated with the whole blood of sandfly fever cases showed a rise of temperature of about 2° F. for the first forty-eight hours after inoculation. Control pigs inoculated with blood from supposedly sandfly fever-free cases failed to show this rise. Two of the control pigs collapsed and died in the first twenty-four hours after inoculation. There was an epidemic of diarrhœa amongst the pigs—only a small number were really healthy before experimentation. Great difficulty was experienced in getting healthy pigs. All the pigs that died were examined, cultures were made of their heart blood, liver and kidneys, and the latter organs sectioned. In no case were spirochætes found. None of the pigs developed any symptoms of epidemic jaundice.

C. Inoculation of Guinea-pigs with Cultures of Spirochætes.—As the primary cultures might contain toxins as well as the spirochætes, they were not used for inoculation experiments on animals or man. Three guinea-pigs were inoculated intraperitoneally with primary subcultures, seven, eight and ten days old respectively. None of these pigs died

or showed any symptoms of jaundice or hæmorrhage. Six guinea-pigs were inoculated with one week old secondary subcultures. One of these pigs died on the 10th day after inoculation. There was neither fever nor any symptoms of note. Attempts to isolate spirochætes from the heart blood, liver and kidneys failed. Six guinea-pigs were inoculated with four weeks' old primary subcultures. One of these pigs died on the 12th day after inoculation without symptoms of fever, hæmorrhage or jaundice, nor could spirochætes be recovered from its blood or organs.

D. Inoculation of Man with Cultures of Spirochætes.—Only three men have been inoculated up to date. Two in an area where sandfly fever occurs, and one in a sandfly fever free area.

Case 1 was inoculated with ½ c.c. of primary subculture (6 days old),
„ 2 „ „ „ ½ c.c. „ „ „ (6 „ „),
„ 3 „ „ „ 1 c.c. „ „ „ (6 weeks old),
and nine days later a further inoculation of 1 c.c. of a six-day old secondary subculture.

In none of the cases was there very definite fever. Case No. 1, had a temperature of 99° F. or over from the 6th to 8th day after inoculation. The highest point registered was 99·8° F. There was pain in the legs and suffusion of the conjunctivæ for several days in cases Nos. 1 and 2. Case No. 3 developed headache, anorexia, marked nausea, tendency to syncope, and pains in the calves on the 7th to 9th days after the first inoculation. The blood picture showed a distinct leucocytosis (15,000 per c.mm.). A similar result, with more pronounced symptoms, lasting for several days, followed the second inoculation.

On account of jaundice developing on the 11th day of disease in one of the sandfly fever cases under investigation in Malta it was considered inadvisable to do further inoculations in man.

E. The Blood Count.—The blood picture showed in practically all the cases a leucopenia (4,000 per c.mm.) for the first three to five days of the disease, followed by a leucocytosis shooting up to 15,000 to 20,000 per c.mm. on or about the 9th to 11th day of disease. This marked rise of the total white count on the 9th to 11th day coincides with a tendency for the fever to relapse in some of the cases. It should be noted that there were distinct relapses of fever in three cases. In one there was a relapse on the 11th day accompanied by jaundice, and a further relapse on the 25th day of disease unaccompanied by jaundice. The fever

recurred on the 11th day in another case, and on the 12th day in a third case. Otherwise the cases selected gave the typical clinical picture of sandfly fever.

F. Wassermann and Agglutination Tests.—These tests were negative in all cases, due allowance being made for the protective inoculation with T.A.B. vaccine.

G. Urine Examination.—The urine in two cases showed a small amount of albumen; one of them also contained bile in a relapse on the 11th day of disease. No spirochætes were found in the urine.

Conclusions.—At present, owing to the inability to transmit the disease in typical form to man or animals, no claim is made to the specificity of the spirochæte isolated. Cross immunity experiments are in progress along lines kindly suggested by Lieut.-Col. H. Marrian Perry, R.A.M.C. The above work was carried out by the Royal Air Force Sandfly Commission, which received very material help from many sources, including Squadron-Leader J. Kelly, M.C., P.M.O., R.A.,F. Malta; Major Newman, R.A.M.C., Malta; Professor H. Noguchi, and various members of the R.A.M. College, Millbank, Lister Institute, Wellcome Bureau of Scientific Research, Medical Research Committee, and London School of Tropical Medicine.

Dr. A. Castellani and Dr. Douglas showed cultures of various fungi isolated from cases of tonsillomycosis—a condition which, in their experience, is much more frequently met with than is generally supposed. The fungi isolated by them belong to the genus Monilia, genus Hemispora and genus Diduim.

Dr. S. H. Daukes exhibited a series of Indian cobras *(Naja tripudians)*, showing variations in colour markings.

Seven Indian cobras, received from Professor W. N. F. Woodland, were shown. All belonged to one species, *Naja tripudians*. The specimens showed a great diversity of colour and marking, but nothing in any way abnormal.

Dr. A. C. Stevenson dealt with some microscopic queries:—

Six sections were shown in two groups of three each. In the first group two sections show a peculiar condition of a group of cells in the

ventral wall of the stomach of the human louse. The cells in this group are distended by a vacuole which contains a mass of bodies of peculiar elongated shape, but with no definite structure. In the third section, bodies of the same appearance are seen in the ovum.

In the second group, two sections were shown of a group of bodies in the axillary fat of a white rat, bred in the laboratory and about a year old. These bodies consist of a thick capsule containing in some instances small uninucleate bodies. In amongst these are sections of curved bodies with thick walls. There are no signs of inflammatory reaction round the mass. The third section shows a piece of obviously vegetable tissue imbedded in the meninges of the brain. Here inflammatory reaction is seen. It is suggested that the brain lesion is primary, and the axillary mass is a growth of a mucor-like mould introduced with the primary lesion.

Dr. C. M. WENYON gave a demonstration on a simple culture medium which he had employed for the cultivation of leptospira and protozoa. He also showed a series of mice which had been permanently cured of a *Trypanosoma equiperdum* infection by means of "Bayer 205."

I. The medium is prepared as follows :—To 270 c.cm. of 0·85 per cent. sodium chloride solution (Ph. 7·6) are added 30 c.cm. of ordinary 2 per cent. bacteriological nutrient agar (Ph. 7·6). When mixture has taken place, 10 c.cm. are placed in each test tube. After autoclaving at 120°C. the tubes are cooled to 50°C., and into each tube are allowed to drop, from a rabbit's ear, 20 drops of blood. The tubes are not shaken nor mixed, and are incubated for twenty-four hours at 37° C. The medium is then ready for use. The blood is obtained from a rabbit by the paraffin method. The animal is enclosed in a box at one end of which is a round opening fitting the neck, through which the head projects. The ear is shaved over the marginal vein. The skin is sterilised with alcoholic iodine solution, and when dry is coated above, below and on the margin with hot melted paraffin, so that the area of operation is covered by a thin layer through which the vein is still visible. With a small sharp knife an incision is made in the marginal vein and the sterile blood allowed to drop from the paraffined margin of the ear into the tubes. After incubation of the blood agar tubes it will often be found that the blood has coagulated in a cylindrical column, leaving a clear agar medium around it.

In this medium *Leptospira icterohæmorrhagica* grows readily, and sub-culture requires to be made every two or three weeks. It was on this medium that Squadron-Leader H. E. WHITTINGHAM isolated the leptospira from cases of sand-fly in Malta.

This medium has also been employed for the culture of certain intestinal protozoa. Thus from the case of *Embadomonas intestinalis* infection referred to by Drs. BROUGHTON-ALCOCK and J. G. THOMSON cultures were obtained. In this case the flagellates grew in association with numerous bacteria. The flagellate has now been carried through several sub-cultures, and it is evident that there will be no difficulty in maintaining it. In the culture both free and encysted forms occur.

In 1918, a species of Embadomonas, similar to *E. intestinalis*, was seen in a guinea-pig in Major URQUHART'S laboratory in Macedonia. Quite recently three guinea-pigs and a wild rat have been found infected with what appears to be the same Embadomonas in England, and cultures from all these animals have also been obtained on this medium. Similarly, a species of Trichomonas and a Blastocystis from the tortoise *Testudo radiata*, kindly supplied by Dr. MANSON-BAHR, is growing well in sub-culture. In the case of these intestinal protozoa, the cultures contain bacteria upon which the flagellates feed.

In the case of the leptospira, of course, no bacteria are present. In a similar manner, in pure culture both *Leishmania donovani* and *L. tropica*, as well as the Leptomonas of the flea and *T. lewisi* grow well in the medium. It has also been successfully used by Mr. C. A. HOARE for the culture of the trypanosome of the sheep and the flagellate from the sheep ked. The temperature of culture is 24° C. to 30° C.

The medium is a modification of NOGUCHI'S serum medium, but it has the advantage of being much more easily prepared, as it involves no separation of serum from the blood, which is dropped directly into the warm agar from the ear of the rabbit. In the preparation of N.N.N. medium for growth of leishmania or other flagellates, the same simple method of introducing the blood to the medium is employed.

A culture of *E. intestinalis* was first obtained by HOGUE (1921) in an egg medium, which has also given good results in the writer's hands. The egg medium is prepared as follows:—LOCKE'S solution is first made: sodium chloride, 1·8 grams; calcium chloride, 0·048 grams; potassium chloride, 0·084 grams; sodium bicarbonate, 0·04 grams; distilled water,

200 c.cm.; to this solution is added one whole egg which has been well whipped. After thoroughly mixing, the solution is steamed for fifteen minutes over the water-bath, with constant stirring, and is then filtered through cotton-wool. About 5 c.cm. of the filtrate is then placed in each test tube. After autoclaving at 120°C. the tubes are ready for use.

II. A series of mice which had been cured of a very heavy infection of *T. equiperdum* over three months before were shown. The animals were treated by intravenous injection of "Bayer 205," the minimum dose required to effect a permanent cure being 0·003 grams of the drug for each kilogram of body weight. Over fifty mice had been treated with this or a larger dose, and there had been no single instance of relapse.

Proceedings of a meeting of the Society held on Thursday, 15th December, 1921, at 8.15 p.m., at 11, Chandos Street, Cavendish Square, W. 1, preceded by a Demonstration at 7.45 of views, photographs and other objects of interest from Mauritius, by Dr. Andrew Balfour, C.B., C.M.G., and Dr. D. E. Anderson.

Sir Ronald Ross, K.C.B., K.C.M.G., F.R.S., in the Chair.

The Chairman: You will be pleased to learn that Professor Mesnil, of the Institut Pasteur, Paris, who is also one of our Honorary Fellows, has been elected to the French Academy, which is a very great honour. I think the Royal Society of Tropical Medicine would do well to send him our congratulations.

This was agreed to unanimously.

A MEDICAL AND SANITARY SURVEY OF MAURITIUS: PAST, PRESENT AND FUTURE.

BY

ANDREW BALFOUR, C.B., C.M.G., M.D.,

Director-in-Chief, Wellcome Bureau of Scientific Research.

I have so many lantern slides to show that I do not intend to read any of the notes which you have already in your hands. The Government of Mauritius reported some time ago that the medical and sanitary conditions there were exceedingly bad, in fact worse than in any other British Dependency. As a result, the Colonial Office decided to send someone out to report on the question, and the lot happened to fall on me. My duties were to investigate, in the short period of six months, the whole conditions, medical and sanitary; to plan a scheme for the reorganisation of the Medical and Health Department, which had fallen into disrepute; and to advise as regards the allocation of a large sum, amounting to nearly a million sterling, which had been raised as a levy on sugar through the efforts of the Governor, Sir HESKETH BELL, for the purpose of carrying into effect necessary reforms and improvements.

I might begin with three famous words of Lord Macaulay, "Every schoolboy knows," and continue, where Mauritius is situated. I can only say that were I to do so I would be guilty of a misstatement. I have two sons—both schoolboys—and I found that neither of them had the vaguest idea as to what part of the world their father was proceeding. Furthermore, in the Municipal Chambers, Port Louis, one of the most treasured exhibits is an envelope which once contained a letter from Buckingham Palace, and which bears the legend, "Mauritius, West Indies." It is also true that a distinguished military officer accepted an appointment in Mauritius, believing it was in the West Indies, and was annoyed to find himself 600 odd miles east of Madagascar!

I would not insult any Fellow of this Society by suggesting for a moment that he was not fully conversant with the geographical position of one of our more venerable colonies, but as memories are apt to be defective it may be well to furnish a few details regarding it.

Mauritius then is an island shaped like an oyster shell, and situated in the Indian Ocean between latitude 19°50' and 20°31' south and longitude 57°18' and 57°48' east of Greenwich. It is thus just within the tropic belt, but, owing to its southerly situation, its immediate surroundings and the influence of the Trade Winds, it by no means conforms to the customary idea of a tropical island. It is nearly 39 miles long and its greatest breadth is 29 miles. Its area closely corresponds to that of Surrey, being 716 square miles, while that of the home county is 758. Moreover, some parts of the island, notably Curepipe and Vacoas, towards the summit of the central plateau, recall in some measure certain features in the scenery of Surrey, and make it hard for the visitor to realise that he is in the southern tropics, many thousands of miles from the heights of Hindhead or the fir-bordered roads of the Farnham district.

So varied is the scenery, so bold are the mountain ranges, so large some of the rivers, that it is difficult to appreciate the fact that one is on a small island. It suggests a continent in miniature, yet it is impossible to go far in any direction without a view of the ocean, that glorious sapphire sea which circles the colony, and whose great breakers beat ceaselessly upon its coral reefs.

In a way Mauritius resembles some of the West Indian islands, yet it is a likeness with a difference, and I am not sure but that the difference is in favour of the old Isle de France, for it is a very lovely and attractive place and possesses advantages unknown in the Western Indies. Certainly, it is more favoured in the way of climate. The latter is mild and equable. According to the *Mauritius Almanac*—that storehouse of information annually compiled with great pains and much labour by Mr. Walter, the learned and energetic Director of the Observatory—the maximum shade temperature recorded at the Observatory, which is situated in the district of Pamplemousses, 178 feet above sea-level, has never exceeded 95°F., while in the highlands, as for example at the residential capital, Curepipe, 1,800 feet above the sea, it rarely reaches 80·4°F.

The relative humidity is high and hence during the summer the heat

is at times oppressive, especially in the lowlands and more particularly in the capital, Port Louis, shut in as the latter is by an encircling belt of hills.

The only taste of the hot weather I experienced was during the month of April, and at that period Port Louis was unpleasant, though not unduly so. April, however, is not the worst month of the year.

From May to the end of September the climate is delightful, though a trifle cold and damp in the loftier parts of the highlands. Curepipe indeed is a very rainy place, so much so that its inhabitants are suspected of having webbed feet! Owing to the high relative humidity it is sometimes disagreeable in the cold weather, though the temperature never and nowhere falls below 44·6°F.

The rainfall varies a good deal in different parts of Mauritius, the mean annual fall ranging from below 29·9 inches on the north and west to 150·9 inches on the central plateau, where in years of maximum rainfall it exceeds 196·8 inches. Rain falls practically all the year round in the higher parts of the island. A distinct wet and dry season can only be differentiated in the coastal regions but, speaking generally, it may be said the rainy season begins in December, reaches a maximum in March and gradually decreases till June. There is a second maximum in August. The dry season occurs in October and November. During cyclonic disturbances, which are not uncommon, torrential rains may fall, a point of importance in connection with anti-malarial works. The physiographical features of the island will be pointed out on the screen. Here I would only say that Mauritius is of volcanic origin and its rocks are thus basaltic, consisting largely of trap, trachyte, and lavas. Some of the lavas are highly porous, and two varieties can be distinguished, *i.e.*, those containing large cavities and those with small pores filled with calcareous infiltrations.

This possibly has an important bearing on health conditions for, in many parts, the ground dries after rain with remarkable rapidity. Hence there are localities where surface water does not remain for any length of time, while outdoor recreation can be taken soon after heavy showers, a matter of considerable hygienic importance.

Fowler, in his excellent *Malarial Investigations in Mauritius*, 1908, distinguishes the following five varieties of soil from which it will be

seen that, as indicated, the above-mentioned condition is by no means universal:—

"(1) The loam variety, which is most common. This is porous and allows water to drain rapidly through it. It contains few springs. This is a healthy soil.

"(2) The red soil, coloured with iron oxide, a loose gravel mixed with clay. Underlying it are often found beds of pure clay, consequently water is liable to collect and stagnate in it. This soil bears an evil reputation as regards malaria. "Terre rouge" and "la fièvre" being almost coincident terms in the season.

"(3) The black clay, extending from a few inches to three feet in depth. A considerable part of Port Louis is built on this, and many other districts, where fever is very prevalent, are composed of the same.

"(4) Sheets of rock, evidently the remains of laval outflow, bare or covered with a shallow top-soil.

"(5) Sandy soil, chiefly along the coast. When mixed with disintegrated coral and decaying vegetable organic matter or rotting seaweed, it has originated outbreaks of several fever epidemics amongst the troops."

As is sometimes forgotten, it is essential to consider soil, sub-soil and deep-lying strata when discussing the effects of telluric conditions on the public health, at least in tropical countries where malaria is rife.

Pictures illustrative of malaria and anti-malarial work form perhaps the most important part of my lantern demonstration, hence it seems only fitting that attention should be directed to the historical aspect of the question, especially as malaria has played a very remarkable rôle in the recent annals of the island.

The work of Ross and Fowler is so well known that there is no need for me to recount how, possibly, the accidental introduction of *Anopheles costalis* into Mauritius, apparently somewhere about 1865, was the cause of a terrible outbreak of the disease. In Port Louis, out of a population of 80,000, 22,231 perished in the short space of thirteen months. Ever since that time malaria has had to be reckoned with in the colony. It has caused the loss of many lives and much treasure, and I firmly believe if Mauritius had not possessed in many parts so porous a soil and been blessed with such a remarkable winter climate it might

easily have been ruined, as was ancient Greece, and as were large tracts of ancient Italy and Spain.

Mauritian doctors have studied and fought the fever; Mauritian entomologists have dealt with its vector; Ross has produced a classic on the subject, and, I am glad to say, conditions have greatly changed for the better.

I am of opinion that still greater changes can be produced, and that, even if the disease and its carrier cannot be utterly stamped out, they can both be so greatly reduced as to be almost negligible. I think and hope we stand at the commencement of a new era, where increased knowledge, sound administration, concerted action, and, above all, ample funds will in a few years revolutionise the situation.

Hence it seems well to look backward for a short space and realise what malaria meant, when, like a pestilence, it ravaged this island of the sea and when 234 people died of the fever in one day in the capital.

In the course of my reading I find the best and most graphic description of the great epidemic, which slew in all 31,920 persons, is to be found in a work bearing the curious title, *Sub-tropical Rambles in the Land of the Aphanapteryx*. This interesting book, which gives a good account of Mauritius in the late sixties of last century, was written by Colonel NICHOLAS PIKE, who was not only American Consul at Port Louis but was an ardent zoologist. Here is what he, as an eye-witness, recorded:—

"Those who inhabited Port Louis during the terrible mortality in 1867 and 1868 will never forget the sad spectacles the city presented daily. Fever! fever! was the only word on every lip, the only thought in every heart. Mourning and desolation everywhere. Scarcely a person visible that did not wear the garb of woe. Song and laughter had ceased.

"Port Louis was once remarkable for the number of pianos heard in every street in an evening, from the Erard's grand and semi-grand to the humblest cottage instrument.

"At this time it was literally 'The daughters of music were brought low, and the voice of mourning was heard in the streets.'

"Funeral trains were met at every corner. Relays of men were kept night and day digging the graves.

"The owners of undertakers' shops that sold mourning, and the

apothecaries, must have made fortunes. The numerous druggists' shops were so crowded day and night, and so short of hands, that it was with difficulty medicine could be procured. Offices were opened in all directions for the distribution of food, medicine, or advice to the destitute; but all the efforts made by the municipality and private charities could not keep pace with the strident progress of the wretchedness and distress.

"There was no mistaking the appearance of one who had suffered: the pallid, drawn features, the skeleton, bloodless fingers, as if the bright life-stream had been dried out of them, and the slow dragging step marked but too plainly the victims.

"It was distressing to pass through the streets: in every corner was some poor creature, suddenly struck down, and crouching on the ground to die.

"In the outskirts of the city and country roads the victims were so numerous that the police and sanitary committees were insufficient to succour half the poor wretches, and many died by the roadsides before help could be brought to them.

"Near Roche Bois I have seen them lying in groups, dying and dead. Not a house, within a radius of half a mile from the one I then occupied, had a living person in it, except at a shop belonging to three Chinamen, two of whom died later.

"In many cases, as soon as a Malabar got the fever, he would hasten to his house and shut himself in to die; for such was the fear of it, to be attacked was the tocsin of death to him.

"I visited many families, and the scenes I witnessed will never be effaced from my memory. A poor Indian, whom I had cured for the time being, came and entreated for help to a comrade. It was night, and I was tired and had gone to bed; but the poor fellow begged so hard that I dressed and went with him. After a long walk we came to a hut, and as I approached I heard groans and lamentations. When I entered the scene baffled all description. A small cocoa-nut oil lamp dimly lighted the interior, adding horror to the scene.

"It was inhabited by a man and his wife, with a number of children. The mother lay dead in the middle of the hut, the man hanging over her in an agony of grief. Her baby, still living, was clasped to her heart,

and seeking to draw its life-sustenance from her cold breast. The other children were all stricken with the fever, and in its last stages, past human help. Of course all I could I did, but help had come too late to do little more than assist in their burial.

" One dreaded to ask the news, as one was quite sure to hear of some friend ill, dying or dead, and often buried before you knew of it. Parents had to rise from their sick beds to nurse their children, and these again had to drag their weary limbs to follow a beloved parent to the tomb, though frequently too weak even to do that.

" No change of weather seemed to arrest the plague. Intense heat or cold, heavy rains or dry, mild calm days, or sharp breezes, all were alike fatal. The brightest morn brought no more hope than the wildest night.

" For months the death-rate in the city alone averaged nearly 200 *per diem*. In every street could be seen the mourning weeds outside the doors where death had struck his victim and this was often the first intelligence you had of the loss of dear friends—no time for ceremony then. May I never witness again the sad sight of those incessant funerals, slowly wending along from morn till night.

" Here a group of Malabars bearing along some poor fellow, preceded by a priest muttering a prayer, and followed by a few women bearing a copper dish of rice and fruit, and a jug of water, to place on his grave.

" There comes a slow and stately train with black-plumed hearse, and a long line of carriages behind it—one of the rich and respected of the land ; anon, a little simple bier, bearing a baby's coffin covered with a simple white muslin pall and wreath, with perhaps only the father and nurse as mourners ; then a white-covered hearse, its white plumes and the horses' sweeping trappings showing that some fair girl had been cut off in early womanhood.

" Occasionally would pass a Chinese funeral, the bier supported by stout Malagash bearers, in their long black gowns and flowing weepers looking as stolid as if of stone ; a few carrioles following with Chinamen in them, and a person always preceding it, scattering pieces of paper about three inches square, often gilt or silvered, all along the road, to scare away evil spirits and prevent their following the corpse to its last resting place.

LINES ON THE CEMETERY AT BOIS MARCHAND.

They lie in thousands side by side,
On that wild desert plain;
The loved, the cherished, nameless there,
By raging fever slain.

In tombs of their ancestral dead
Their bones may never lie;
No marble records shield their graves
Beneath that torrid sky.

O'er that blent mass of human clay
No mourners bend in tears;
No wreaths, no votive offerings there,
Though the loss will be felt for years.

For there the grey-haired grandsire lies,
With the darlings he loved so well;
And there the bride of a few short hours—
Of such griefs what tongue may tell?

The mother with her first-born babe,
The father in manhood's pride;
The fairest and best were swept away—
Our friends so trusted and tried.

Long, long will the "Gem of the Ocean" rue
The fever fiend's deadly rage;
For sadder sights than its shores have seen
Rest not in History's page."

Let us hope he was a better naturalist than he was a poet. The verses which I have read to you do greater credit to his heart than to his head, for neither his scansion nor his imagery is above criticism. Still they must have a place in the literature of malaria.

I found his succeeding remarks on the etiology of the disease so curious and interesting that I have transcribed them. Remember he was working in the dark and that he was not a medical man. In any case the medical men of the period had very similar views and the authority he quotes in support of his argument was, I believe, a doctor. Thanks to LAVERAN, MANSON, ROSS, GRASSI and many others, we know better nowadays and can explain, for example, why people living near marshes at a high altitude, such as Mare aux Vacoas and Bassin Blanc, escaped the fever.

"Everywhere one heard the questions, 'What have been the predisposing causes of the epidemic? and what are the existing causes of its long continuance?'

"Whatever may be the difference in opinion as to the origin and modes of propagation, all agree that certain states of the air favour the

disposition of the body to receive intermittent and remittent fevers, and rivet them into the constitution, which baffle all attempts at complete cure, and induce a tendency to relapse from apparently slight causes.

"The concurrence of cold with a moist atmosphere; heavy rains after long dry weather: weakness of body, whether owing to poor and unwholesome diet, fatigue, severe evacuations, or previous diseases; anxiety of mind; inactivity, intemperance, or restlessness, all increase susceptibility; while hope, confidence, cheerfulness, whatever can excite mental energy, lessen it.

"Differing as intermittent and remittent fevers do in many points, particularly in their rate of mortality, they yet agree in their origin as occasioned by effluvia emanating from putrid, stagnant waters, swampy low grounds, and animal matter. It is found in the tropics that malarious diseases are most common in the seasons succeeding heavy rains, when the temperature is high, and where the surrounding country abounds with jungles, and insect life is rife.

"It is now well ascertained that gases, emanating from decomposed vegetable and animal matter, generate confervaceous as well as diatomaceous plants, such as *Tetraspora nostoc* and all the genera Agaria.

"These cryptogams are never found in *dry* warm situations, but where it is *damp* and warm, and they develop themselves especially where organic matter is in a state of putrefaction.

"Some of these plants live on the surface of stagnant waters, but very many on the surface of low lands. Others are parasites on plants, which they destroy, as is shown in the diseases of the vine and potato.

"In *Oidium tuckeri* the spores are so small that EHRENBURG, the great microscopist, was scarcely able to detect the form of a thousand of them, grouped together, with the highest power of the microscope. Our knowledge of the elementary structure of organisms is exclusively based on microscopic discoveries, and modern physiology is the result. Organic chemistry has materially participated in the development, but the microscope excels the chemical re-agents in practical usefulness, both as to precision and facility, and has firmly established its superiority in histology and physiology.

"Through the medium of these fundamental branches it has benefited medical science at large, and of late has lent material aid as well to diagnosis.

" Sometimes it may delude and give rise to erroneous inferences, but the chances are in such a case it is the performer or an imperfect instrument that is at fault.

" It more frequently reveals the true state of elementary structure and its deviation from the normal state, and thus aids as well as corrects pathological knowledge.

" In a long-continued series of observations, in cases of persons who have died of fever, when particular organs and their secretions were submitted to minute microscopic examination, it was almost invariably found that the membrane lining the stomach was covered with a multitude of very minute plants, closely resembling the Alga, *Cryptococcus cerevisiæ*. These parasites often covered the whole intestinal tract ; some were perceptible on the surface of the lungs, and some could be detected in the blood. In the latter, it sometimes happened that there were epithelial cells, apparently containing fatty and pigment molecules.

" On living patients, in the advanced stage of the fever, they may be detected, by one well acquainted with the microscope, in the substance which is formed at the corners of the mouth and eyes.

" Some of the parasites appear quite hollow, others contain nuclei and spores, and others show cell articulations.

" In the secretions of entirely healthy persons they cannot be detected.

" Water taken up in well-cleaned basins out of some isolated pools at Grand River, or where its waters mingle with the sea, and subjected to the rays of the sun till stagnant, developed a green superficial film. Under the microscope this film showed plants so nearly related in shape and structure to those in and on the different organs of the human body, that there is no doubt of their being of the same genera, and it is equally certain that they were exciting causes of the epidemic.

" Myriads of these plants were generated all over the island ; and when matured, the spores became free, and were taken up by the wind and carried from place to place. These spores were thus inhaled, and if the stomach was not in a morbid condition, they would pass out without effecting or undergoing any change, or be destroyed by the gastric juices ; if, on the contrary, it contained material highly susceptible of fermentation (which the universal rice and vegetable diet here tends to), the spores would germinate and grow, produce inflammation, and fever readily ensued.

"Unlike phanerogamous plants, which absorb carbonic acid gas, depositing the carbon in the plant, and throwing off the oxygen into the atmosphere, all the lower class of cryptogams absorb oxygen, and consequently give out carbon, thus vitiating the atmosphere we breathe.

"It may not be out of place to mention here that the physiological effects of the cinchona bark, and its alkaloids, on vegetables, animals and men, should be borne in mind, as the connection of these effects with the therapeutical influence of the bark in fever was until lately inexplicable.

"DECONDOLLE states that leaves of plants immersed in an infusion of pale bark were dried in twenty-four hours; and others, plunged into a solution of quinia water, presented evidences of contraction in from six to eight hours.

"It is evident, therefore, why this remedy, when used in malarious fevers, acts so beneficially. By this contraction, or process of withering, it destroys the fast growth of the poisonous fungoids in the system, and, if there is no complication, eradicates the disease.

"This fever is only contagious under certain circumstances. Knowing how it is germinated, it will be readily perceived that when a person is attacked with it, in damp unventilated places, it follows as a matter of course, that from the moment the spores in or on the patient become free, all the inmates of the same place, and especially when they are crowded together and filthy in their habits, will be subjected to the disease; and in so far only is it communicable.

"Since writing the above, I met with an interesting article on 'The Causes of Ague,' and as it bore so forcibly on what I had written, I transcribe some of its paragraphs at length.

"'The fertile source of desolation and disease consists of incalculable myriads of microscopic cells, suspended in the atmosphere over waste, marshy, and fen districts. They are minute oblong cells, single or aggregate, and having a distinct nucleus, with a clear interspace, apparently empty, between it and the cell wall. They are of the algoid type, strongly resembling the Palmella, and are consequently amongst the very lowest organisms known. Sometimes several of these cells or spores are contained in an outer cell or wall, or delicate investing membrane, to form a plant.

"'Of these "ague plants" is formed the greyish film wherever damp, black earth is turned up and exposed to the sun. These spores or minute

seeds (germinating cells) rise into the air, carrying pestilence with them. There are several species of the "ague plant," which have been called Gemiasma, from the Greek for earth, and the word miasma. The white, and a yellowish-green variety, occur usually in a non-calcareous soil, and produce agues of but slight intensity, and are the only ones known in England. There are also red, green, and lead-coloured "ague plants," and one singular species, the "*Gemiasma protuberosa*," which has larger spores, "and consists of groups of jelly-like protuberances."

"'These latter kind habitually occur in rich calcareous soils, and produce fevers of a dangerous and congestive character.

"'The cells with their spores produce visible incrustations of mould on the surface of recently exposed marsh earth. The danger from these growths is greatest in a hot dry season following a wet one. The wetter and hotter, the worse for man, and the better for malaria.

"'The marsh demon is verily "the pestilence that walketh in darkness." It seems almost certain that the spores of the "ague plant" only rise with the evening dews. Microscopically tested, the day air is free from those organisms.

"'In different parts of the world these cryptogamic spores rise in the night mists to definite heights.

"'In the United States they seldom rise more than from thirty-five to sixty-five feet above the low levels; in England not more than from fifteen to thirty feet.

"'These spores are found throughout these vapours, but do not extend beyond them, and are found in the greatest abundance in their upper strata.

"'Intermittent or ague fever has actually been produced in men by causing them to inhale the spores of these algæ.

"'It has long been known that malaria is movable by the wind, the spores of the "ague plants" having risen and become entangled in the mist; spores, mist and all are blown along together, far perhaps from the place of germination.

"'This fact admits of considerable practical application in tropical climates, where the wind usually blows for a long time from the same quarter. It is easy to see how a volume of vapour or fog, laden with its deadly burden of poison-cells, may roll up and hang suspended on the side of a hill, towards which a wind blows across an adjacent marsh.

"'Instances have occurred where the poisonous vapour has been blown over a hill, and deposited on the other side, to the unmitigated disgust of the inhabitants, who imagined themselves secure from their pestilential neighbour.'

"The above article applies particularly to Mauritius, as I shall endeavour to show by a slight description of the numerous hot beds of the 'ague plants' with which the island abounds at the present day.

"I will begin with the very focus of malaria, Port Louis, and mention a few of the numerous causes of infection in that city alone.

"The foul streams flowing through it in all directions are, two-thirds of the year, almost stagnant; the other third they are swollen by the torrential rains, and bear along masses of vegetable and animal matter from the hills and Indian camps, which, as the waters subside, lie festering in the sun, poisoning the atmosphere.

"The emanations from the open drains, the imperfect drainage of the houses, and the defective method of disinfecting the night-soil, load the air with mephitic vapours.

"The gradual filling-up of the east end of the harbour from the mud constantly pouring into it, and the tide not being strong enough to wash away the impurities that lodge in the muddy bottom, adds its quota to the malaria.

"The low shores to the west of the city are only covered at high tides, and are strewn with decayed sea-weed and filth, washed in from the shipping.

"Between Port Louis and Port William lies a swamp, that receives into its rank vegetation the streams that flow from the cemeteries and another swampy land at the back of them. These cemeteries contain in themselves a very sufficient cause of malaria. The emanations from them are at times most deadly, owing to the circumstances that the dead are not interred deeply enough, and the loose earth and coral which cover them permit the escape of the gases evolved by their decomposition.

"It has been frequently remarked that the health of the city has invariably suffered from the miasma from its western side that has been blown over it.

"Between Port Louis and Grand River are low lands, prolific in the germs of malaria. After heavy rain the Grand River swells, and receives

into its floods filth of every kind, which is swept down, or deposited all over its course, or left in pools to decompose in the sun.

"Near its entrance to the sea, where the waste water spreads out all over the wide embouchure made by the torrents of ages, and the rapidity of the flood abates, it has not power to sweep away all the débris, and part always remains filling up its channel, and impeding its proper egress to the ocean. The whole of this district, and the neighbouring one of Petite Rivière, lie low.

"Just before the fever broke out at Petite Rivière, there was a large camp of Indians located there, reeking with indescribable filth. The huts crowded to excess, men and beasts herded together; and with the ordinary dirty habits of the men, and the scarcity of water in that district during the severe drought at the end of 1866, the wonder is the fever left any of them alive.

"Very few indeed were spared; and it is a melancholy sight, at the end of 1867, to pass by the camp. Here and there you meet a poor squalid wretch, and a few weakly children; but nearly all the huts were destroyed that had contained whole families, now swept away, and the few that remained, shut up—it looked like a city of the dead, after teeming with busy noisy life as it did some months previously.

"The ill effects of allowing the Indians to wash their clothes and bathe in the running streams, thus polluting the waters in their whole course, were well shown during the epidemic, as death with unceasing energy stalked amongst those who lived near such waters, and used them unfiltered.

"The marshes of Pamplemousses and the West Savanne; the moist lowlands of Petite Savanne; the shallow tidal lagoons west of Black River; and all the low coast-line receiving the drainage from the central watershed, gave out their poisonous exhalations.

"During 1867 some parts of the island entirely escaped; most probably lying above the spore level, or fever line, which I see Dr. Reid, the chief medical officer, places at 600 feet above the level of the sea.

"In his report on the fever, he mentions a curious fact about the spread of the fever into a section of Black River and Savanne, always known as the healthiest part of Mauritius. Between these districts and the infected ones lies a barrier of forests and woody elevations. He writes, 'During the first week of January, 1868, occurred a hurricane, the

main force of which was from the south-east and east, in that extremity of the island sufficiently strong to spoil the forests of their leaves, and make gaps in this barrier of wooded highlands, and thus carried in the fever germs from the part of Black River, where fever was rife, to the hitherto healthy inhabitants.'

"I could add greatly to these details: but those I have mentioned are sufficient to show that, with all these existing powerful agents to malaria lying dormant, and so many spore-beds waiting for peculiar atmospheric influences to set them free, the heavy rains, and then excessive drought followed by hurricanes, would act on them with fatal certainty, and thus strike the whole island with this terrible plague, converting, for the time being, the once 'Gem of the Ocean' into a very pest-house.

"Dr. REID also mentions in the same report a circumstance which would seem to corroborate the fact alluded to on p. 98, as to the effects of the cinchona, as stated by DECANDOLLE.

"He says, 'The waters of the few remaining woodland marshes of Mauritius, the Mare aux Vacoas, aux Joncs, and Bassin Blanc, are deeply tinged and impregnated with tannin and resinous matters, and the inhabitants around and near these marshes entirely escaped the fever.'

"He suggests, and very properly, 'May not this exemption be due to the tannin, and other products of the débris of the surrounding forest, being present in these localities, and preventing the fever germs from flourishing therein? May not the removal from the humus and marshes of the lowlands of similar substances, which they received when the island was well wooded, have been one of the changes which prepared them for the reception and development of amalarious germs?'

"I do not doubt it; and it is most likely the withering effects of the different barks in solution, that prevented the germination of the fever-spores in those marshes, and caused the consequent immunity of the neighbouring inhabitants from the disease."

I do not think it is a waste of the Society's valuable time to see how men groped in darkness and how they tried to explain phenomena which nowadays we fully understand. In respect of certain diseases we stand where they stood as regards malaria, and a consideration of their errors and of their strivings towards the light may aid us to avoid pitfalls and guide us to a correct explanation of the problems with which we are faced.

Some of these exist to-day in Mauritius, which we shall now study from various aspects of hygiene by means of lantern slides prepared from photographs I took during six months' inspection and advisory work in this famous and unique little colony, which the 1921 census has shown to possess a population of 376,108, of whom the great majority are Indians.

Over 120 lantern slides were exhibited illustrative of the following subjects:—

1. Geography of Mauritius.
2. Scenery of the island.
3. Malaria and antimalarial work.
4. Mosquitoes other than anophelines and antimosquito work.
5. Water supplies.
6. Washing arrangements.
7. Waste-water disposal.
8. Food.
9. Conservancy.
10. Refuse and refuse disposal.
11. Plague.
12. Ankylostomiasis.
13. Buildings of various kinds and sanitary and insanitary premises.

A selection of the above is here reproduced to illustrate the more important points considered:—

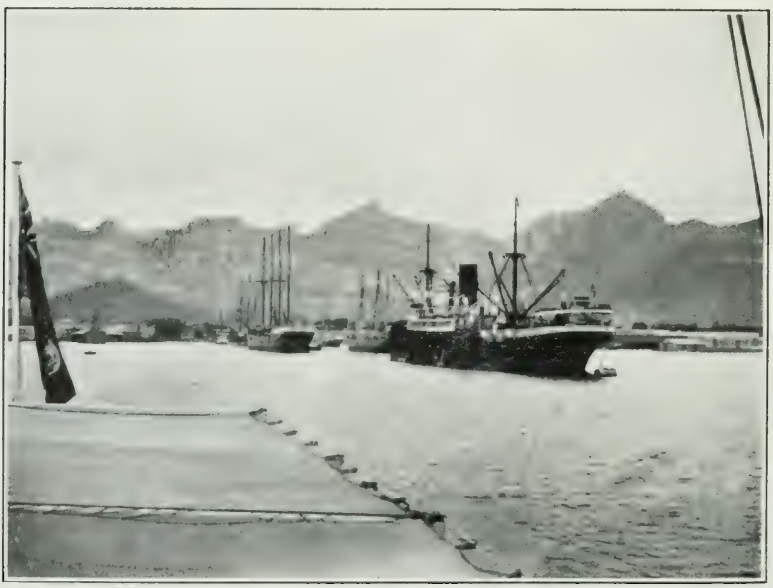
Geography.—A map of Mauritius was exhibited and the chief physiographical features of the island explained. Special attention was directed to the intensely malarious Black River district, an area of comparatively level land lying between high hill ranges and the sea.

Scenery.—Various views were shown, especially of the waterfalls, for which Mauritius is famous. Pictures of certain of the hill ranges and the larger rivers were also exhibited, together with illustrations of the beautiful coast scenery. Slides of Port Louis and its harbour formed a feature of this section, and an old plan of the capital showed the general layout of the town and its immediate surroundings Stress was laid on the Port's similarity in many respects to Port of Spain, Trinidad, and, from the point of view of plague, attention was directed to the fact that large ocean-going ships lie out in the harbour and do not tie up to wharves or quays.

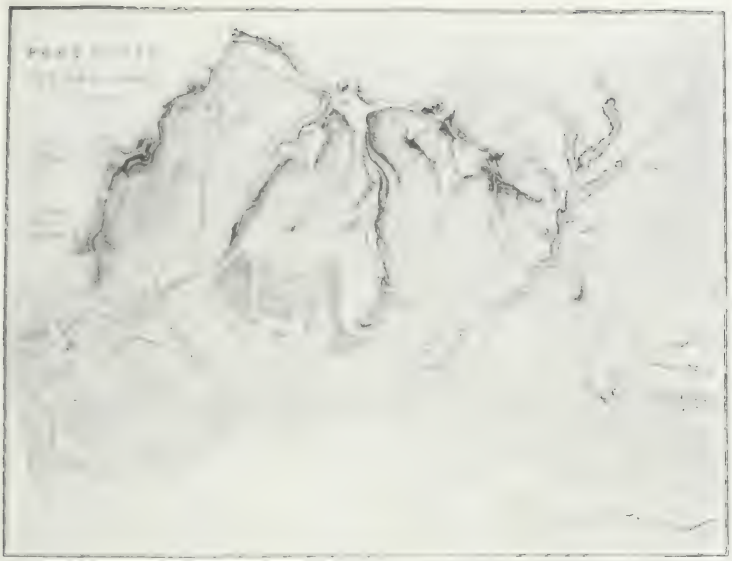
1.—The island is well supplied with both roads and railways.

2.—The Moka Hill Range from Pamplemousses, showing the lofty summits of Pieter Both on the left and the Pouce in the centre.

3.—Dia Mamour Falls, Grand River, S.E.

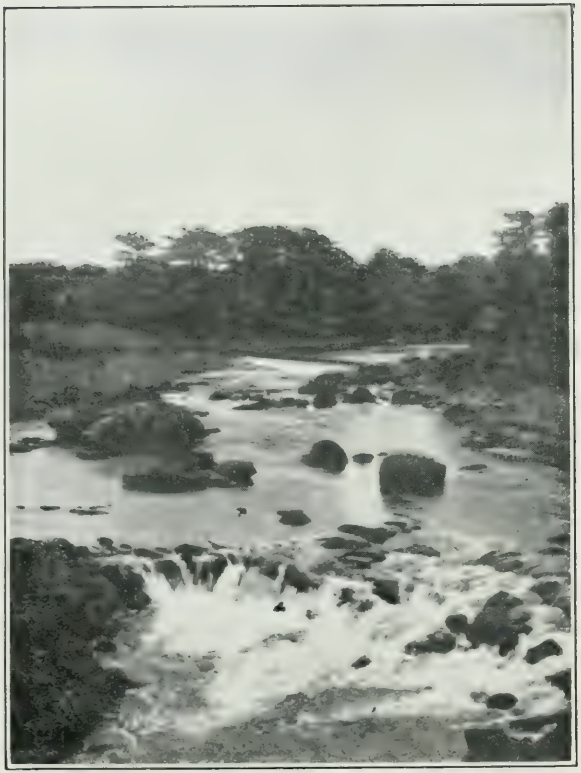


4. View of Port Louis Harbour and Town from the sea, showing the Moka Range in the background with the Pouce Mountain in the centre.

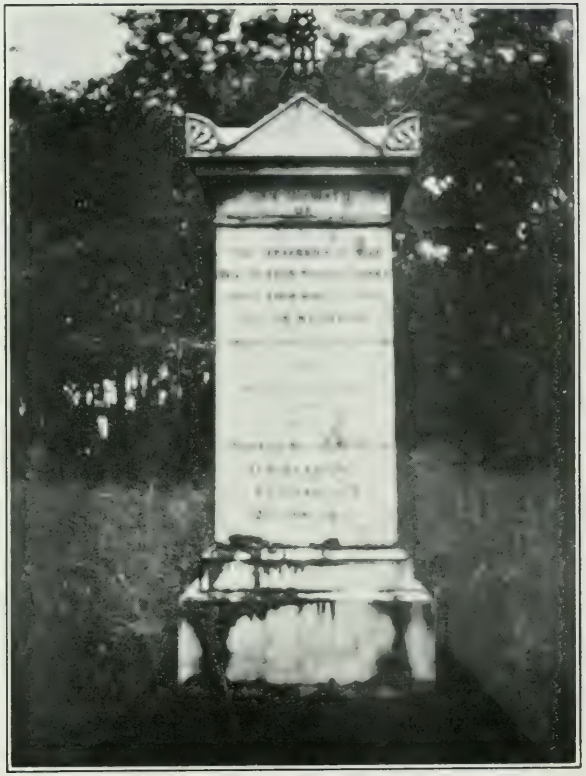


5. -Old map of Port Louis, showing the relations of the town to the surrounding hill ranges. The town is now not so extensive as here indicated, a considerable portion of it having been destroyed by the great hurricane of 1892, and never having been rebuilt.

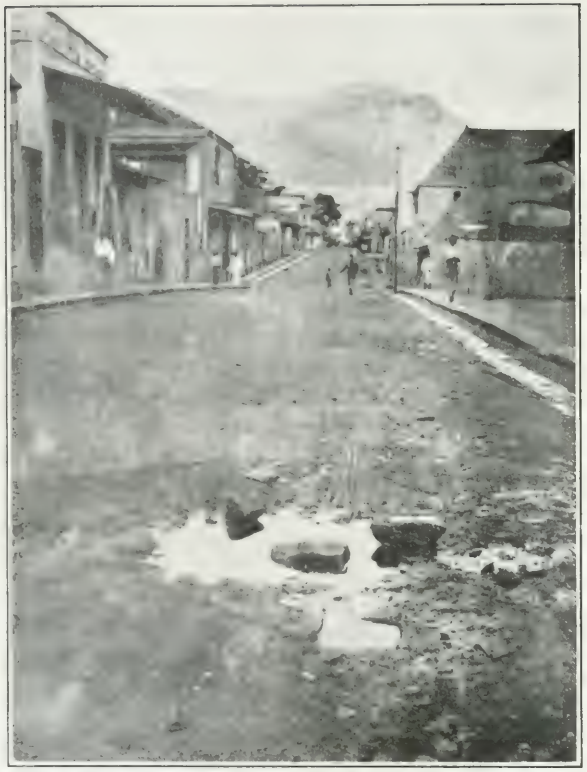
6. View across Baie du Cap. The mass of Morne Brabant in the background



7—View of Grand River, S E



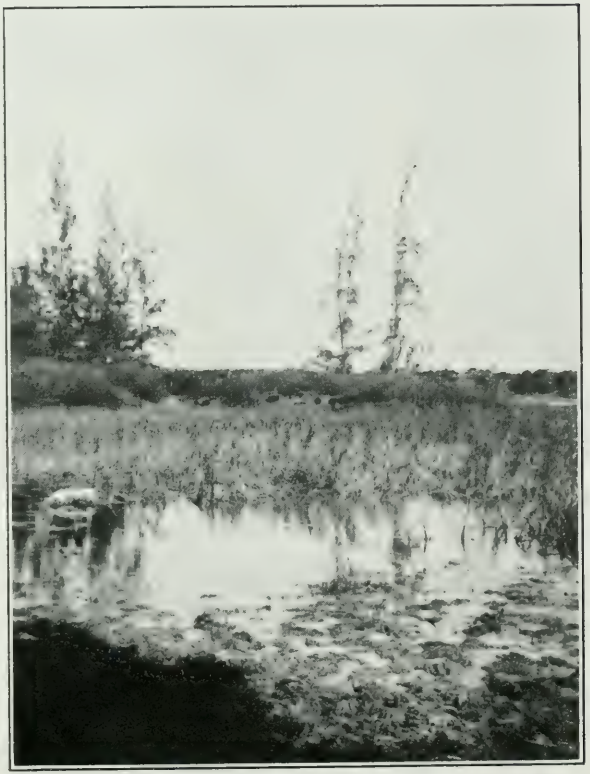
8. Monument in the Bois Marchand Cemetery to a large number of the men of the Mauritian Police Force who died of malaria during the great epidemic.



9. A leaking "Regard" in one of the Port Louis streets—breeding-place for *Anopheles costalis*.

10. An overgrown and neglected watercourse on a sugar estate. Pamplemousses.

11.—Uncanalised River Françoise near Poste de Flacq.



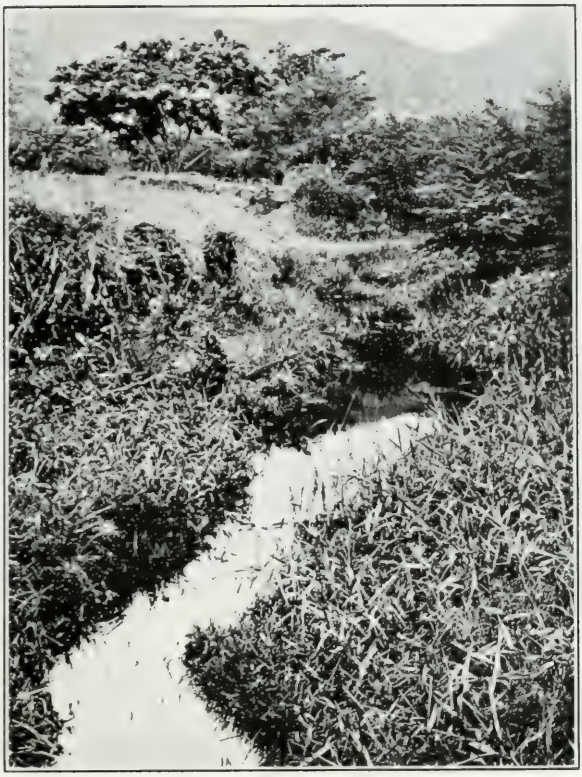
12.—A typical marine swamp in the north of the island.

13.—An inland swamp at La Lucie, Fracq.

14.—La Ferme Reservoir. The water is at a comparatively low level and convenient breeding-places for *A. costalis* are provided.

15.—Portion of Black River at the time of Ross' and Fowler's visit, 1908

16.—Same portion of Black River at the present time.



17.—La Paix stream at the time of Ross' and Fowler's visit, 1908.

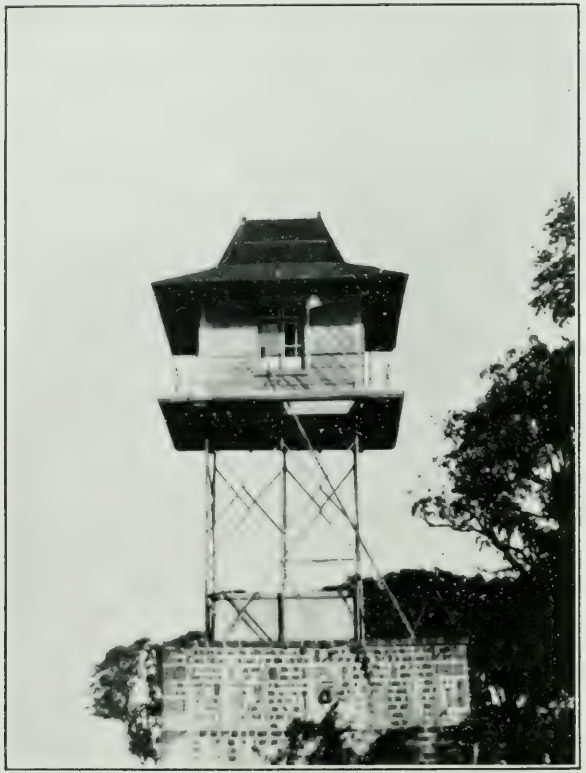
18.—La Paix Stream. Very nearly the same spot during the dry season at the present date.

19. Mosquito trap-pool protected by rabbit wire netting from the assaults of pigs and other animals.

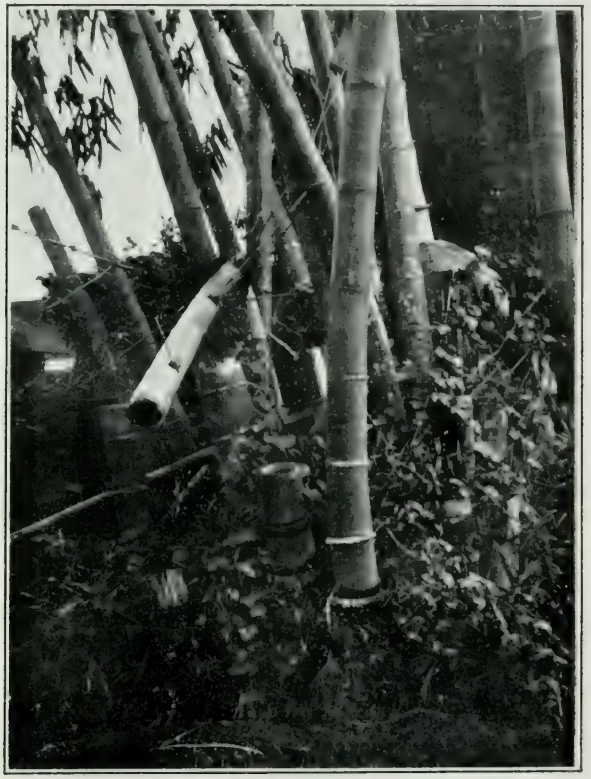
20. Canalised stream shaded by Jamrosa trees (*Eugenia jamrosa*) and free from the larvæ of *A. costalis*.

21.—Canalisation of a water-course traversing Port Louis. Note the excellent old Pavé, the side drains and the hill range in the background.

22.—The canalised Rivière Seche, District of Flacq.



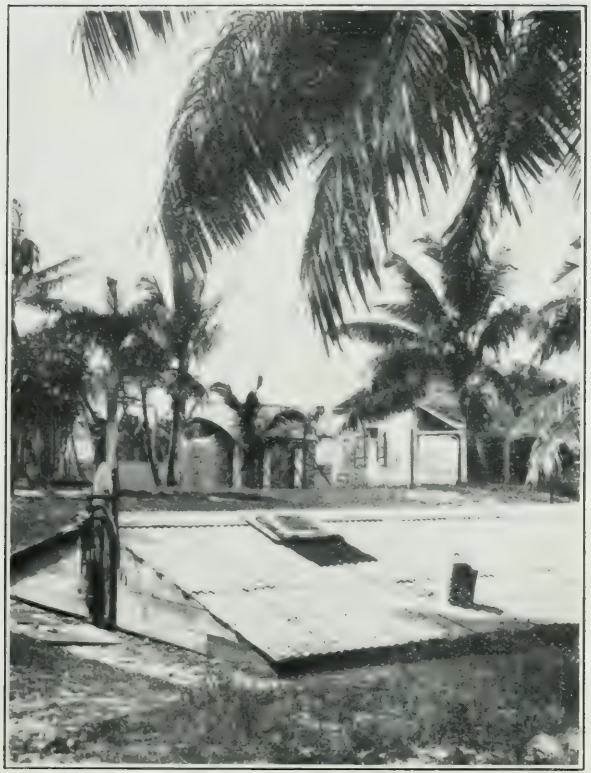
23.– A "mosquito tower" in Pamplemousses district.



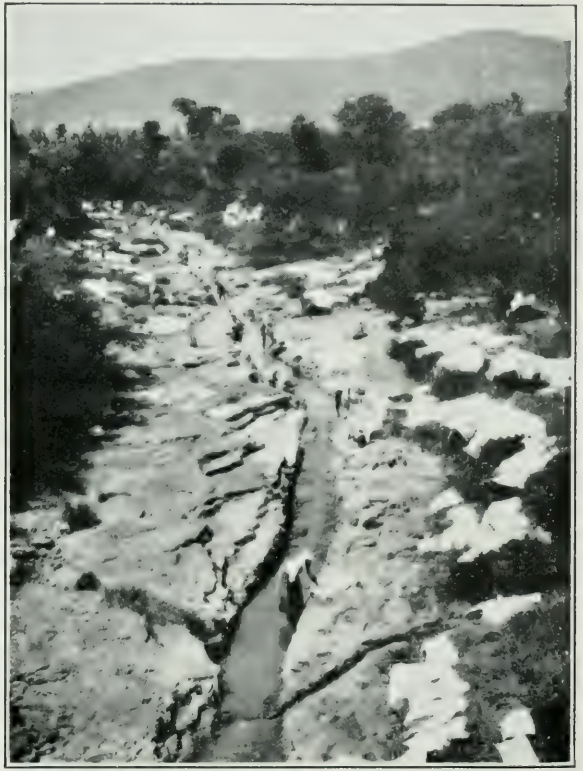
24.—Bamboos broken by hurricane and forming nurseries for the larvæ of *Stegomyia scutellaris*.

25. One of the ever-running taps leading not only to a great waste of water, but to the formation of mosquito breeding-places—outskirts of Port Louis.

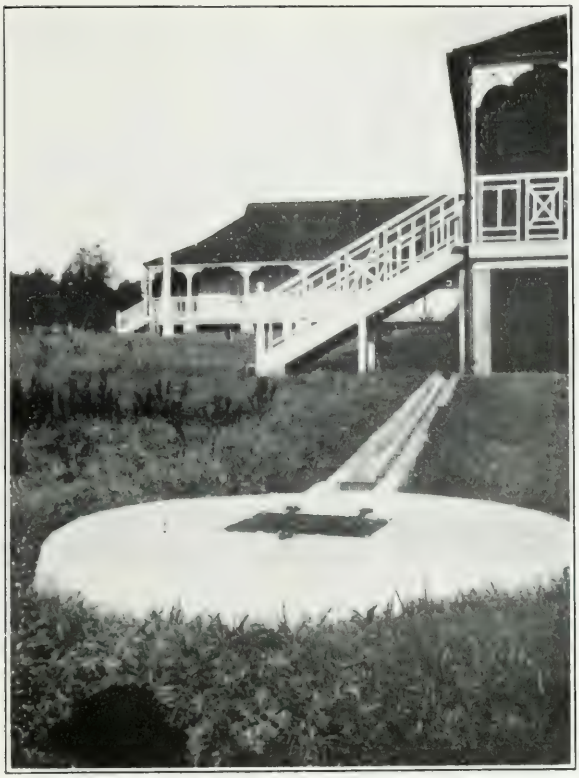
26.—A well-cover made from the end of a sugar-factory boiler. Ample opportunities for pollution during the drawing of water.



27.—Underground rainwater-tank, Quarantine Station, Canonnier's Point. The water is derived from roof-washings, and as the first washings are not rejected, is somewhat impure. Moreover, the pump had broken down, and consequently resort has been had to dipping, which tended towards pollution of the supply.

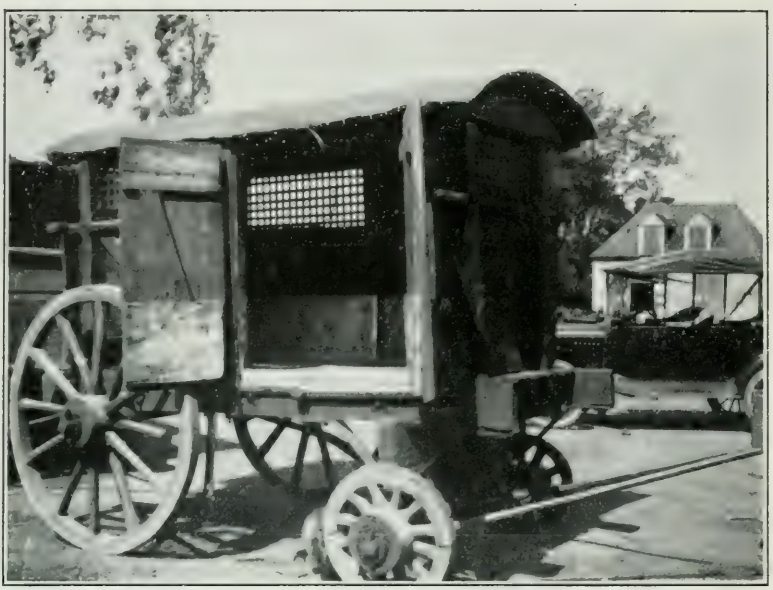


28.—Latanier stream near Port Louis, showing native washer-women at work. This photograph also shows how the stream has been canalised in solid rock.

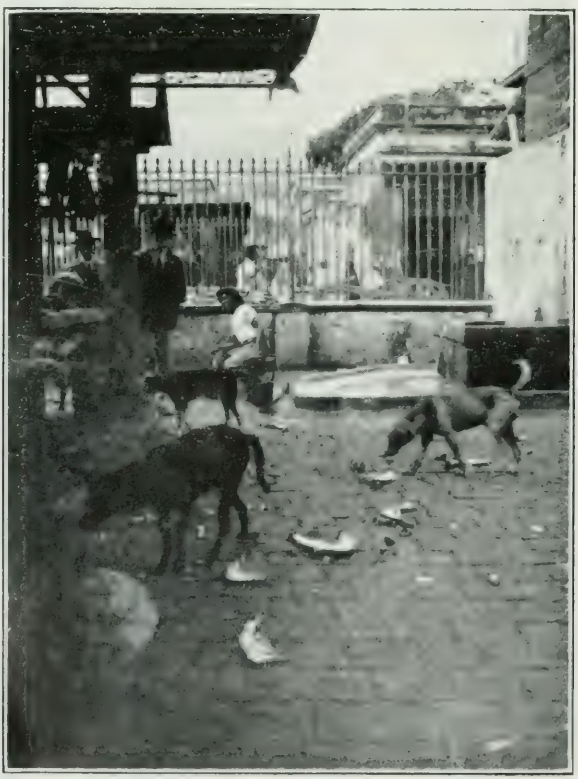


29.—Disposal of waste water. Arrangements at British Barracks at Vacaos. Large covered soak-pit in foreground. The soil here is very porous.

30.—Group of milk-vendors. Tins are of a fairly good type, but their contents only faintly resemble milk, as the product from the cow has had the fat removed, has been boiled, and had water added to it. Nearly the whole milk supply of the island is in a very unsatisfactory condition.



31. A strange and antiquated vehicle employed for conveying meat from the slaughter-house to the market, Port Louis. It is lined with zinc, but, as will be seen, the fly-proofing is distinctly defective. As a matter of fact the gratings are more for ventilation than for the exclusion of flies.



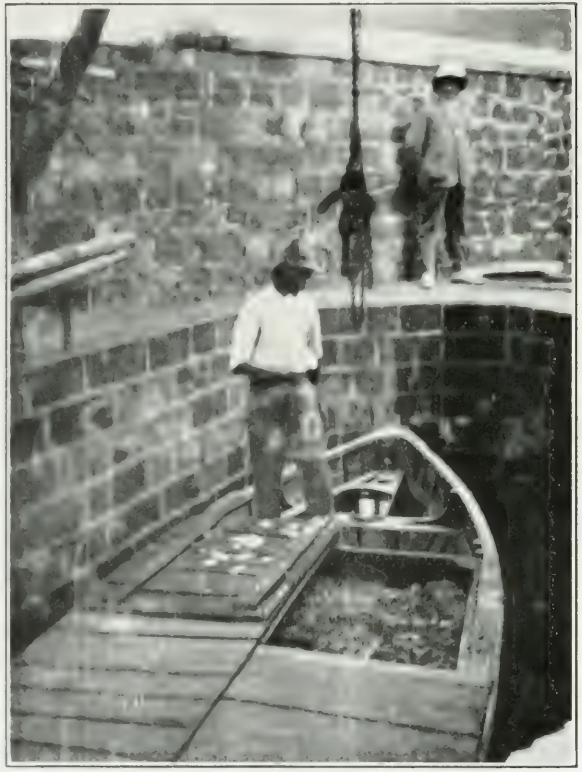
32.—A corner of the central meat market, Port Louis. A story not needing words

33. Large covered market in Curepipe. This is the only really good market in Mauritius.

34.—Fish form a staple article of diet in Mauritius, and the photograph shows a basket of fine white mullet.

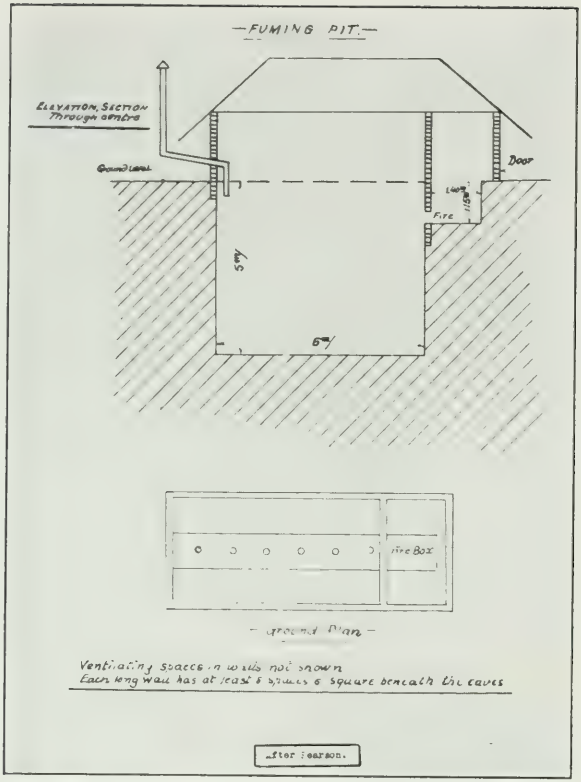
35. -A typical night-soil cart. Port Louis. It is furnished with sliding-doors, which render the interior dark. The tubs are of wood, and become very foul.

36.—An open type of engrais or manure pit. The sweeper is shown emptying the contents of a latrine bucket into the cement concrete tank The human excrement is mixed with cane trash and rubbish of various kinds, and the mass is eventually used for manuring the cane-fields.

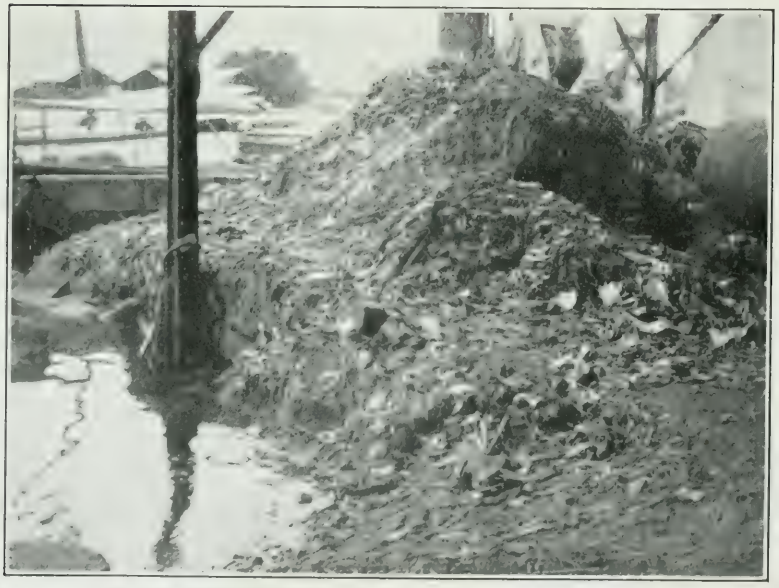


37. – Boat employed for removing a portion of the contents of the sewers, which, owing to partial failure of the pumps and the small size of the outfall are insufficient to deal with the total daily flow. The boat discharges its contents in or outside the harbour and is a happy hunting ground for flies.

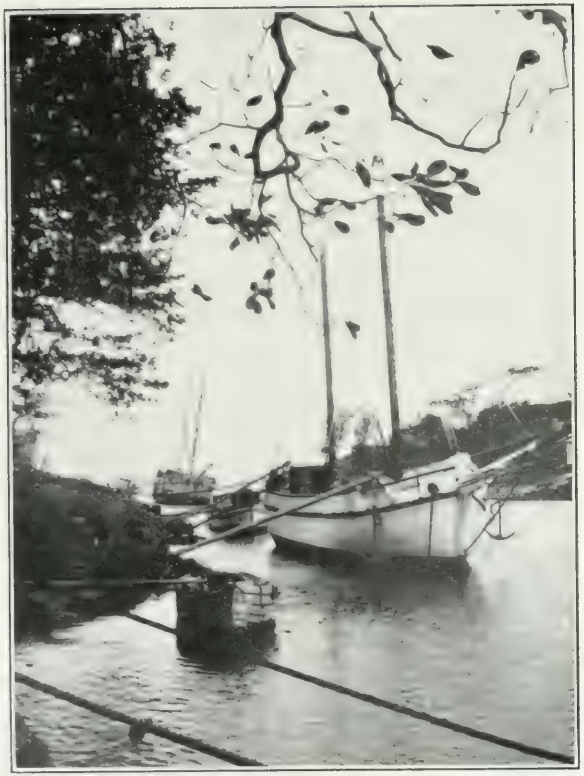
38. Interior of one of the pits at the Roche Bois Manure Factory, Fort Louis. The containing wall is broken and pigs have access to the human excrement.



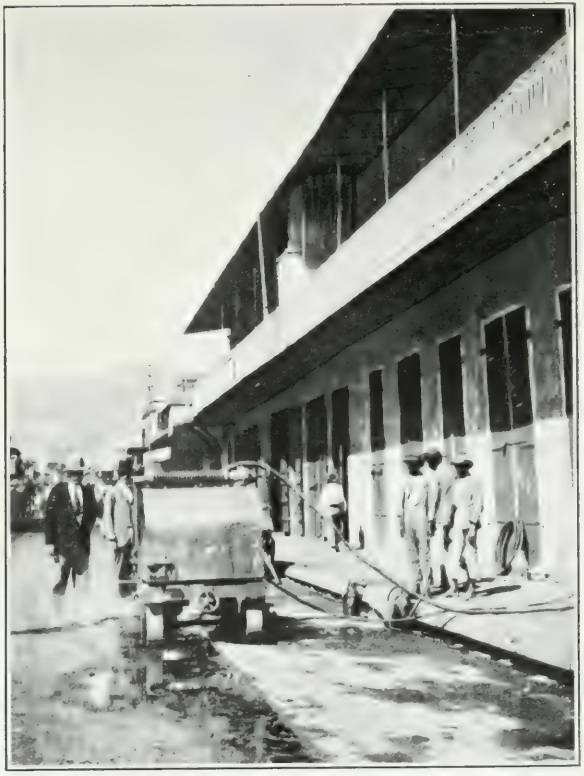
39.—Plan of fuming-pit as now employed in parts of the Belgian Congo. These pits are being introduced into the sugar estates in Mauritius.



40 A refuse heap and rat playground on the harbour front, Port Louis.



41. Coasting vessels at Souillac, showing lack of precautions as regards the ingress and egress of rats.



42.—A Clayton apparatus at work during the plague epidemic in Port Louis.

43.—This illustrates the stunting effect of ankylostomiasis on growth. The boy in white is a victim of hookworm disease and is sixteen years of age. The other boy is twelve and was found uninfected.

44.—One of the male wards of the Leper Asylum, at St. Lazare, Port Louis. Note the grass brooms which are manufactured by the lepers, and sold by them to the general public.

45. Type of insanitary yard. Port Louis.

46.—Type of better-class Indian's house.

47. —A Sugar Estate Crèche, where the children are looked after while their mothers are at work.

48. —Portion of the model village being erected by Sir Hesketh Bell at Cassis, on the outskirts of Port Louis.

49.—The Bacteriological Laboratory, Réduit.

50.—Date-palm, showing the nests of weaver birds placed at the ends of the leaf fronds as a protection against monkeys, and exemplifying the truth of the proverb, "Prevention is better than cure."

Malaria.—In the first place, a picture was exhibited of a tombstone in the Bois Marchand cemetery, erected to a large number of the members of the police force who died during the terrible malaria epidemic of 1866 to 1868.

Following this, a series of views was displayed, showing the various breeding-places of *Anopheles costalis*, both in urban and rural districts. So far as the former is concerned, the liability of the so-called "Regards," which are prevalent in Port Louis, to form mosquito nurseries was made the subject of comment. It was explained that a "Regard" was a pit in the street, containing the junction of the pipe from the water-main and the supply-pipes to the house. Owing to the fact that the water of Port Louis, being unfiltered, contains much silt, a blockage is apt to take place at the point of junction. The householder endeavours to remedy this by tampering with the screw-down taps, and, as a result, leakage frequently occurs, and mosquitoes gain access to the water in the pit. Mention was made of a device designed to take the place of the "Regards" and render them unnecessary.

The rural breeding-places comprised swamps (both marine and inland), rivers, streams, ponds, irrigation pits and canals, and special attention was directed to the fact that *Anopheles costalis* does not breed in streams shaded by trees, because the green alga on which its larvæ feed is not found in such situations. Mention was made of Dr. CASTEL'S observations in this connection.

A map was then exhibited which showed the very extensive major antimalarial works which had been carried out in the island since Major Ross's visit, and a further idea of what had been done was given by a number of slides showing various kinds of antimalarial operations, more especially those connected with the training and canalisation of rivers and streams. In two instances it was possible to compare pictorially the conditions at the time of Ross's visit and those which now obtain, and a very marked change was visible in the case of a stream in the neighbourhood of Port Louis and a river in the Black River district. The question of *Lemna minor* as a mosquito deterrent was discussed, and the statement made that the work of the SERGENTS in Algiers had apparently shown that this water-weed has not the beneficial effect of *Azolla filiculoides* in preventing ovipositing in sluggish streams and ponds.

A picture of a trap-pool was shown, and the use and value of these

contrivances explained; while a mosquito-tower was displayed somewhat similar to those used for preventive purposes at certain railway stations in the Caucasus. Other antimalarial measures were discussed, and attention was then directed to—

Non-malaria-carrying mosquitoes and the measures taken to deal with them.—The rôle of *Culex fatigans* as a carrier of filariasis was mentioned, and the statement made that in all probability *Stegomyia albopicta (scutellaris)*, which is so common in the island, was also a vector, as was known to be the case in Malaya. One of its favourite breeding-places, namely, flower-vases in cemeteries, was shown, in addition to such nurseries as snail-shells, barrels, and broken bamboo stems.

Water Supplies—Pictures showing the aerating and oxidation plants at the La Marie Filter Works paved the way for the consideration of many matters connected with water supply in Mauritius. The source, storage, and distribution of water were all passed in review, and pictures illustrating fouling of well-waters formed a feature of this section Comment was made on the waste of drinking-water and its attendant evils, and the measures taken to remedy these evils were explained and illustrated.

Washing.—The manner in which streams and rivers are fouled by the custom of washing clothes in them was next shown on the screen, together with a picture of an open-air laundry.

Waste-water Disposal.—Under "Waste-water Disposal" a single slide was exhibited, which showed the excellent arrangements in connection with the British barracks at Vacoas, where the great porosity of the soil enables well-constructed absorption pits to function admirably.

Food.—Examples of different kinds of food-stuff were shown on the screen, both the necessities and luxuries being represented. Special attention was directed to the question of milk supply, and pictures of cowsheds and milk sellers helped in the elucidation of the subject. The lecturer ranged from slaughter-houses to markets, and the insanitary condition of the central market in Port Louis, and the means taken to remedy it, figured prominently. The excellent, large, covered market at Curepipe received a meed of praise, and then attention was directed to various—

Conservancy Problems, and pictures were shown illustrating the comparative failure of the sewerage scheme in Port Louis, its success in connec-

tion with the British barracks at Vacaos, and the deplorable conditions existing in connection with the pail system of removal, so general in the island, and more especially the disgraceful state of matters at the Roche Bois Manure Factory near Port Louis, and the somewhat similar establishment which serves Curepipe. The so-called Engrais system was explained and condemned, and some of the remedial measures proposed were illustrated by appropriate slides, notably, the introduction of the "fuming pit" or smoke latrine system, as now practised on a large scale in the Belgian Congo.

Refuse and Refuse Disposal.—These received attention, and the danger of faulty scavenging in connection with the spread of plague by rats was indicated by several illustrations. This led to the exhibition of a series of slides connected with—

Plague and the Anti-Rat Campaign in Port Louis. Amongst others, the Clayton apparatus was shown at work, and the possibility of danger from island schooners tying up to wharves explained.

Then followed No. 12, a picture showing the stunting effect on growth by—

Ankylostomiasis, which is so prevalent in Mauritius, and mention was made of the aid which is to be rendered by the Rockefeller Foundation. The question of—

Housing was thereafter taken up, and a number of photographs passed in review, illustrating not only various dwellings but showing special institutions, as, for example, a crèche on a sugar estate, different kinds of hospital wards, and the model village recently erected by the Governor, Sir Hesketh Bell, at Cassis, near Port Louis.

Pictures of dipping tanks for cattle were also exhibited, and special attention was drawn to a photograph of the useful Bacteriological Laboratory at Réduit, of which Dr. Barbeau is in charge. Its value from the point of view of preventive work was emphasised, and, finally, the lesson that prevention is better than cure was inculcated by a picture of a date-palm, which showed at the very extremity of its fronds the nests of weaver birds placed there as a protection against the attacks of monkeys.

In the course of the demonstration tributes were paid to the work of several Mauritian doctors and entomologists. The lecturer acknowledged the assistance rendered him by many officials, notably his Excellency the Governor and Mr. E. B. Denham, C.M.G., the able and energetic Colonial

Secretary. Mention was also made of the good work which was being accomplished in Port Louis by the recently appointed Medical Officer of Health, Dr. T. B. GILCHRIST, who would soon be a Fellow of the Society, and of the advantages likely to accrue from the recent visit of a Consulting Sanitary Engineer in the person of Mr. E. L. MANSERGH.

If only Mauritius were freed from those plagues we have considered, and others which render it notoriously unhealthy, its future might, I believe, be assured. There could be no more delightful holiday resort, and no great distance away lies the Union of South Africa, a large and wealthy country developing by leaps and bounds. It has a population, especially in Johannesburg, which looks for rest and change, and nowhere could these be better enjoyed than in the old home of the dodo. At present people are deterred from going there owing to its unenviable reputation for unhealthiness, but if this were abolished there is no reason why hotels should not be built, large golf links laid out and various developments undertaken.

It is possible that thereby the island might lose some of its charm, but it would benefit financially, and it might be expected that its hygienic condition would materially improve, if only because further funds would be available for the upkeep of sanitary works.

All this is no vain dream. We know what has been done elsewhere, wherever modern knowledge has been applied vigorously and along sound lines.

It is only by hard and incessant work that Mauritius can be rendered healthy, but its transformation from a disease-stricken colony to one noted for salubrity is undoubtedly a feasible proposition. It is a question of money, energy, co-operation, education, application of scientific principles, and persistence. The thing can be done, and it is certainly worth doing.

Hence let us hope that now a start has been made under more favourable auspices than in the past there will be no back-sliding, but a steady progress towards the twin goals of health and efficiency.

In the olden days Mauritius, the ancient Isle de France, gained for itself the proud title of the Star and Key of the Indian Ocean. I hope yet to see it become, as apparently it was many years ago, a veritable Sanatorium, a Star of Hope to the sufferer, a Key to the Door of Health.

Discussion.

The Chairman: I think we must congratulate Dr. Balfour on that very fine lecture which he has just given us, and the beautiful photographs. You will excuse me for saying that it has delighted me beyond measure to hear all these things, and to see in these pictures parts of Mauritius which I had never seen before when I spent nearly fourteen months there with Major Fowler. At that time we had only to deal with malaria. I have not heard much of what happened in the island since then. Mr. De Charmoy was there at that time, and I believe he is still there, though not at the same work. They have not carried out all the recommendations in my report. Dr. Castel, the head of the malaria part of the work, ought to have had his attention confined to malaria. They take one's advice in part, but not fully.

I am glad to hear the island has progressed, and that there has been some improvement, though, apparently, not such great improvement as has occurred in Cyprus. I went to Cyprus in 1913, and there the reduction of disease had been very marked.

I am delighted to hear Dr. Balfour mention my proposal that we should introduce *Anopheles rossi* into the island; but they would not allow it. I do not know why. I only thought of it just before leaving; I had not time to press it. But I think it might eat out the *costalis*. As to the Mauritianus, I do not think that carries; we could not get a single malaria parasite to develop in that, but the first *costalis* we caught was infected.

All the other sanitary details which Dr. Balfour has given us are exceedingly interesting, and he has shown his usual wit and dash in his lecture, and, as I have said, we must congratulate him on it.

I shall not say any more, but I will call upon Dr. Laurent, who was formerly mayor of Port Louis; he was mayor of that town when we were there, and he helped us very largely. I have a great opinion of the municipality of Port Louis. They have an Opera there, which shows that they look after their sanitation, and Dr. Laurent was looking after the sanitation very considerably when I was in the island.

Dr. Eugène Laurent: I am pleased to meet here an old friend, Sir Ronald Ross, and to make a new acquaintance, Dr. Andrew Balfour; because during my stay in Mauritius Dr. Ross was sent as an

expert, and he did very good work there indeed. He is right when he says the Government never helped him a bit, and he knows that practically all the work which has been done has been done by the municipality. In the drainage, for instance, we had a splendid expert, Sir Osborn Chadwick, who certainly gave the necessary directions, and even left Mr. Brine to carry out his directions, yet the whole thing was messed considerably by the Government, who tried all the time for economy, and especially delays. The Government has been at the drainage of the island for thirty-one years, and Dr. Balfour has given you instances of what the Government did in Mauritius for sanitation. Beyond this, you know that in the suburbs of Port Louis, which might well be called the ante-room of death, the Government has full sway. You will remember, Sir, that I took you round the streams of Rushbury, Maure Rouge, Valley Piteau, and so on, and you saw that all those places had been sadly neglected ; so much so that the municipal zone was overcrowded by people who had migrated from the Government zone. I think that is a crucial test. If people migrate to the maligned municipal zone to escape malaria, that is the answer to those who criticise the municipality. Had there been sufficient money available, I think the excellent directions given by Sir Ronald Ross would have been more successfully and thoroughly carried out by the municipality. I wanted, in 1917, before I left the island, to have a clear indication of the work done by the Government and by the municipality ; so I got our sanitary wardens to take the spleen rates in the different schools in the municipal zone and in the zone directly under the control of the Government. The schools under our control gave a 10 per cent. spleen index, whereas on the Government side it ran up to 74 per cent. So that evidently the work done since 1908, the date of the visit of Sir Ronald Ross, was much more efficient when done by the municipality than was done by the Government. Dr. Balfour has forgotten to tell you that before 1867 the island was certainly a sanatorium. But we have now had introduced there so many Indians, for working on our sugar plantations, that apparently all the diseases upon earth were introduced at the same time to our native coolies. And, somehow, the Medical and Health Department, under the control of the Government, did nothing to prevent the introduction of disease, and when disease was introduced there was the greatest difficulty in eradicating it. I think that with the new

instructions given by Dr. BALFOUR, and with the co-operation of the public, something useful will be done. In fact the municipality, now having more money, will be able to do much of what was left undone owing to lack of sufficient means. You know that in 1908 we had to get Commissioners in Mauritius to look into our finance; the Government had been so improvident that we were on the verge of bankruptcy. But, even at that time, the municipality had no deficit, whereas the Government had more than a million pounds deficit yearly. So, altogether, you see the management was not so unwise on the part of the free institution.

I am sure you will join me in congratulating Dr. BALFOUR on a most useful report, which he has presented this evening, on Mauritius. Everything was very interesting indeed, and, for my part, I enjoyed it thoroughly. I beg to propose a vote of thanks to Dr. BALFOUR, who was your worthy successor.

This was carried, and Dr. BALFOUR very briefly acknowledged it.

SHORT PAPERS.*

A PRELIMINARY NOTE ON BILHARZIOSIS INDIGENOUS IN PORTUGAL.

By CARLOS FRANÇA M.D., *Naturalist to the Bocage Museum, Lisbon.*

An indigenous case of Bilharziosis, due to *Schistosoma hæmatobium*, was recently discovered at Tavira (Algarve, Southern Portugal) by the urologist, Dr. Bastos Lopes. Several other similar cases were subsequently diagnosed and studied in the same locality by Dr. Machado d'Almeida. As a result of these discoveries, I undertook to study the matter from the parasitological standpoint.

I have found that one of the snails occurring in this district—*Planorbis corneus* L. var. *metidjensis* Forbes, an Ibero-Algerian variety—exercises a very definite chemiotactic action upon the miracidia obtained from the eggs passed in the urine of some of these indigenous cases; and I have further been able to observe the penetration of the miracidia into the bodies of these molluscs. Contrary to Lutz's observations on *S. mansoni*, I find that the miracidia of *S. hæmatobium* do not select the tentacles as their point of entry, but usually enter the snout, the margin of the foot, or even the gill.

I have observed that the miracidia, which are so strongly attracted by *P. corneus metidjensis* (a species containing abundant hæmoglobin), are attracted only exceptionally (1 out of 60) by *P. albus*. *P. crista*, *Physa acuta*, and *Limnæa peregra* are not attacked at all. In one specimen of *P. albus*, obtained from a locality where there is no bilharziosis, I have found bifid-tailed cercariæ without eye-spots; but I have not yet been able to identify them. In the pond from which our cases appear to have acquired their infection I have as yet succeeded in finding only two species of snail—*Physa acuta* and *P. corneus*. Of the latter species, only dead specimens are, as a rule, discoverable.

*With a view to making the Transactions more interesting, it is proposed to insert SHORT COMMUNICATIONS from Fellows relative to any matters of medical, sanitary or parasitological interest. It is felt that many Fellows in various parts of the world must be in a position to contribute short papers on these subjects, and the Secretaries will be pleased to receive any such from them.

So far as I have been able to ascertain up to the present, the hatching of the eggs of *S. hæmatobium* takes place with great difficulty in waters from granitic soils. My experiments indicate that the great majority of individuals of *P. corneus* die within a short time after being attacked, and in such dead specimens I have found well-developed sporocysts. This pronounced pathogenic action of *S. hæmatobium* upon *P. corneus* doubtless explains the slow spread of bilharziosis in our country.

Frequency curves based upon the lengths of the eggs of *S. hæmatobium* show certain points of interest, and I am pursuing this line of investigation further. The eggs usually measure 133μ to 143μ in length; but their dimensions are variable, and the variation seems to follow a definite law, which is shown in the frequency curves that I have constructed. These curves appear to have some importance in connection with the interpretation of the effects of treatment.

Although we are still only at the beginning of our investigations, we believe that the results which we have so far obtained are worthy of immediate publication. Winter has already commenced, and it will therefore be impossible to finish our study of the problem this year. Our results appear to us, moreover, to raise a question of very great hygienic importance—that of the possible acclimatization of bilharziosis in Europe. Fears were formerly entertained that the Schistosomes might spread to Europe; but these fears seem to have been set at rest by the researches of Lortet (1905), and especially by those of Roubaud (1918). Our observations appear to us to open up the whole problem anew.

Fortunately, *S. hæmatobium* appears to be established at present in only a very small area in Portugal; and it seems legitimate to hope that, before long, the disease will become extinct among us. The lesson will, however, remain; and it clearly teaches us that imported carriers of bilharzia may constitute a source of danger to Europe unless they are rendered innocuous by treatment with tartar emetic.

In conclusion, I desire to thank Mr. Clifford Dobell for his kindness in helping me to prepare this note for publication in English.

Collares, Portugal.

8 October, 1921.

ON SOME HELMINTH PARASITES OF AN EAST AFRICAN ROCK RABBIT (PROCAVIA SP.).

By Miss M. TURNER, M.Sc.,
Helminthological Department, London School of Tropical Medicine.

During his stay in German East Africa, Captain G. Norman Hall, M.R.C.V.S., of the Veterinary Department, Dar-es-Salaam, made an extensive collection of the helminth parasites of various animals. Through the kindness of Captain Hall and of Dr. Bartlett, of the London Hospital, this collection was forwarded for diagnosis to the Helminthological Department of the London School of Tropical Medicine. Among the specimens were some parasites from Rock Rabbits which had been shot at Dodoma, near Mpapua.

Further examination showed that these included the following nematodes:—*Deletrocephalus brachylaimus*, von Linstow, 1901, *Hoplodontophorus flagellum*, Hemprich & Ehrenberg, 1828, nov. gen., *Crossophorus collaris*, H. & E., 1828.

deletrocephalus brachylaimus, von Linstow, 1901.

Owing to the presence of a very long bursa in the male of this species the two sexes are almost equal in length, but the female is stouter than the male. The anterior end of the body is markedly tapering and the head is small in proportion to the rest of the body.

The cuticle is transversely striated at intervals of from 25μ to 30μ (von Linstow gives 21μ).

The œsophagus is from 300μ to 375μ in length. It has a constriction at from 80μ to 125μ from its anterior end and where the nerve ring is situated; behind this the œsophagus dilates until it reaches a diameter of from 125μ to 200μ.

The position of the cervical papillæ is characteristic for they are from 800μ to 840μ from the anterior end of the body; this means that they

are situated almost one and a half times the length of the œsophagus behind the commencement of the intestine. The excretory pore opens in front of the cervical papillæ at about 650μ from the anterior end of the body.

The wall of the intestine, except at its commencement, is impregnated with a brownish pigment.

A mouth collar is present and is relatively high, being from 22μ to 30μ in height. At its base it is 104μ to 130μ wide, while at its anterior end it is from 80μ to 105μ wide: in optical section its lateral margins are trilobed.

The lateral head papillæ end anteriorly in the middle lobe of the mouth collar and do not project far. The submedian head papillæ project in front of the mouth collar, and each consists of a conical base, from which arises a narrow club-like process.

The mouth capsule is ellipsoidal in shape, with its longer axis dorso-ventral. In optical section the mouth capsule walls are from 15μ to 25μ in height, and vary from semi-circular to triangular in shape. The breadth of the mouth capsule is from 60μ to 65μ laterally and from 75μ to 80μ dorso-ventrally.

On the anterior end of the œsophagus is a rim of cuticle into which the mouth capsule fits. In optical section this rim appears as a small pointed projection on each side of the mouth capsule.

Arising from the level of the base of the mouth capsule is a corona of about thirty pointed leaves. Owing to its ellipsoidal shape, this corona appears wider in lateral view than in dorsal or ventral.

In his description of *D. brachylaimus*, VON LINSTOW has apparently mistaken the identity of the several parts of the head region: thus he speaks of "four large papillæ at the base of the head prominence, in the submedian lines." As far as can be made out from his figure these "papillæ" seem to be the optical sections of the mouth capsule. Also, he has evidently taken the fibres leading to the submedian papillæ for the optical section of the mouth capsule, and mistakes the leaves of the corona for rods in the wall of this "capsule."

Female.—VON LINSTOW gives the length of the female as 20mm. and its breath as 880μ. In the material from German East Africa, the mature females measured from 11mm. to 15mm. in length and from 700μ to 725μ in breadth. The tail is rounded with a small point at its

DELETROCEPHALUS BRACHYLAIMUS
(V.L. 1901).

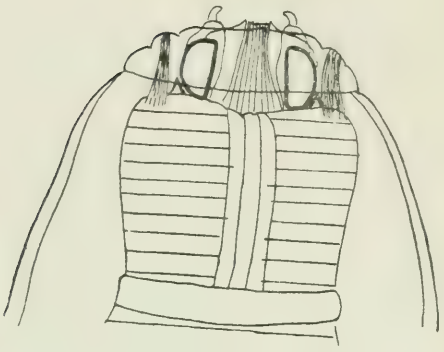


Fig. 1.
ANTERIOR REGION OF BODY.

HOPLODONTOPHORUS FLAGELLUM
(H. & E. 1828).

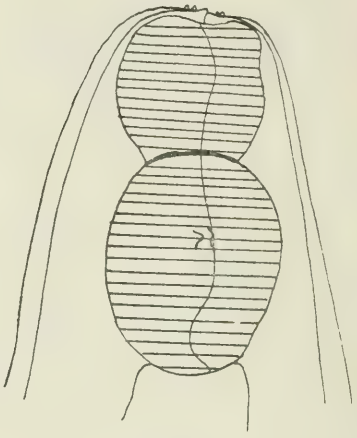
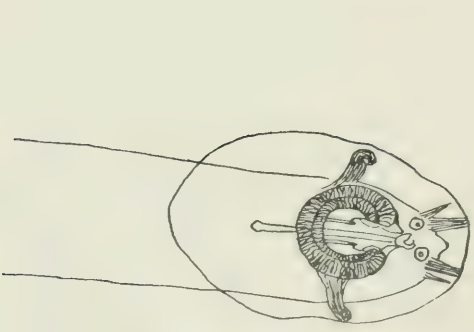


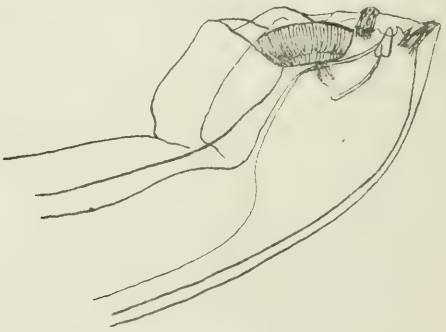
Fig. 5.
ANTERIOR END OF BODY.

HOPLODONTOPHORUS FLAGELLUM (H. & E. 1828).

Fig. 6.
POSTERIOR REGION OF MALE.



VENTRAL VIEW.



LATERAL VIEW.

DELETROCEPHALUS BRACHYLAIMUS (V.L. 1901).

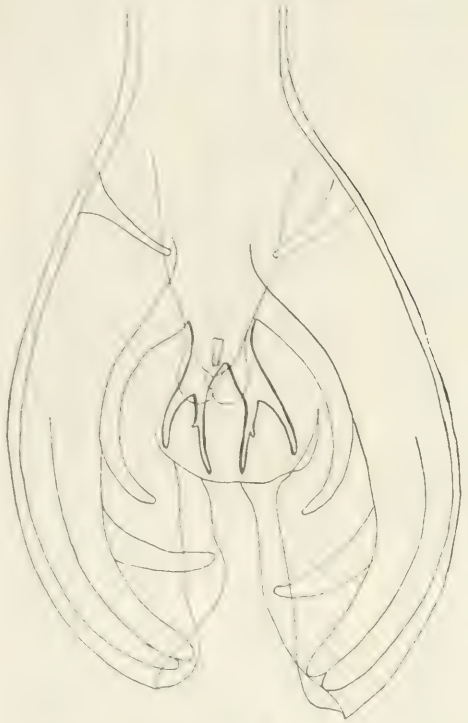


Fig. 2.
DORSAL VIEW OF BURSA.

Fig. 3.
LATERAL VIEW OF BURSA.

POSTERIOR REGION OF FEMALE.

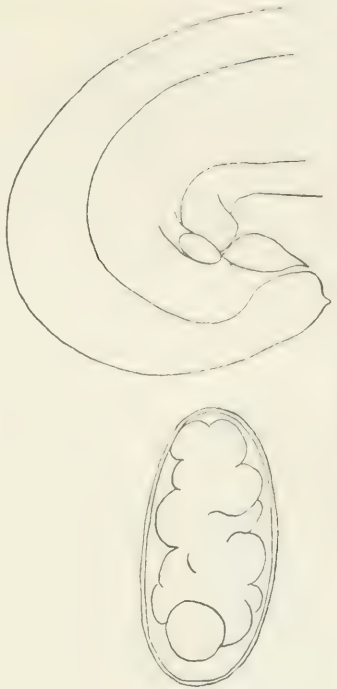


Fig. 4.
EGG × 220.

extremity; it is variable in appearance, for in some specimens a large ventral prominence is seen just in front of the anus, while in others the tail is bent ventrally. In some females an outstanding cuff of cuticle, about 900μ in length, is present in this region.

The anus is from 75μ to 100μ in front of the terminal point; while the vulva, which sometimes opens at the apex of a prominence, is about 200μ in front of the anus.

The eggs are oval and thin shelled: they measure from 150μ in length by 65μ in breadth to 152μ in length by 72μ in breadth.

Male.—The total length of the male is from 9·5mm. to 13mm. and of this 1·25mm. to 1·55mm. is accounted for by the bursa. The breadth of the body at its widest part is from 450μ to 550μ.

The genital cone is very long, with a well developed dorsal collar. The pre-bursal rays are thick and pointed.

A gubernaculum is present.

The two spicules are thin and are from 3·1mm. to 3·5mm. in length (VON LINSTOW gives 2·96mm); each has a simple point at its distal end.

The bursa has two large lateral lobes, which are from 1·25mm. to 1·55mm. long, and a smaller median lobe which is about 0·9mm in length. The dorsal ray is bifid, each part dividing into two branches, of which the internal bears a small process on its outer side. In my material this internal branch is only slightly longer than the external one, but VON LINSTOW figures it as over twice as long as the latter. VON LINSTOW also states that the externo-dorsal and dorsal rays apparently arise separately, but in my material they arise together, and the externo-dorsal ray curves away from the dorsal just before the latter bifurcates.

VON LINSTOW figures the cleft between the internal lateral and the median lateral rays as about twice as long as that between the latter and the externo-dorsal. In my material these clefts are of equal length. The ventral rays are not separated throughout the proximal half of their length.

HALL says that it is not certain that *D. brachylainus*, VON LINSTOW, 1901, is congeneric with *D. dimidiatus*, DIESING, 1851, which is the type species of the genus Deletrocephalus. The fact that in the latter there are six projections from the base of the mouth capsule, which are

absent in the former, is an important point of difference between the two forms.

HOPLODONTOPHORUS FLAGELLUM (HEMPRICH AND EHRENBERG, 1828). NOV. GEN.

HEMPRICH and EHRENBERG first described the female of this nematode from *Hyrax syriacus*, and called it *Oxyuris flagellum*. However, on the discovery of the male in my material, it was decided to remove it from the genus Oxyuris and place it in a new genus Hoplodontophorus, on account of the presence of a ventral sucker in the male.

Definition of *Genus Hoplodontophorus*: Male with peculiarly sculptured horseshoe-shaped sucker on the ventral surface anterior to the cloaca. Well developed bursa present. Œsophagus as in *Oxyuris curvula*, short and with an œsophageal bulb. Mouth surrounded by six pointed inconspicuous lips.

Description of *Hoplodontophorus flagellum*. The male is only from one quarter to one half as long as the female, and about half as broad.

The œsophagus is short, and approximately equal in length with the œsophageal bulb. The nerve ring is situated about the middle of the œsophagus.

HEMPRICH and EHRENBERG probably mistook the small points of the lips for papillæ.

Female.—The female is from 17mm. to 32mm. long and from 1mm. to 1·2mm. broad in the region of the vulva. Just behind this the body becomes slightly broader and then gradually tapers to the anus. A short distance behind the anus the body narrows abruptly to form the long, thin tail, the distal end of which is rounded and ends in a very small point.

The œsophagus is 0·3mm. in length by 0·25mm. to 0·3mm. in width. The œsophageal bulb is from 0·35mm. to 0·45mm. long by from 0·3mm. to 0·35mm. wide.

The vulva is from one-fifth to one-third the length of the body, from the anterior end: its lips are swollen and project from the body wall. The ovaries are found in the region of the vulva. Their ducts pass backwards to a point just in front of the anus, where the large uterus commences. This passes forwards to a level anterior of the vulva, where it turns backwards as the short vagina.

The anus is from one-fifth to one-third of the length of the body from the extremity of the tail.

The eggs are flattened on one side and measure from 110μ by 42μ to 115μ by 45μ.

HEMPRICH and EHRENBERG note two "varieties" of their *Oxyuris flagellum*: (*a*) "obtusa," which is yellow in colour, and has a curved tail that is more than one-third of the length of the body, and (*b*) "acuta," which is white in colour and has a straight tail which does not exceed one-third the body length.

In the material from German East Africa, both white and yellow forms are present. The latter are packed with eggs while the former contain very few. This seems to account for the difference in colour. In my material, as HEMPRICH and EHRENBERG noted in *Oxyuris flagellum*, the tail of a yellow specimen seems to be longer in proportion to the rest of the body than that of a white one. This, however, is not a specific difference.

Male.—Measures from 7·7mm. to 8·4mm. in length and from 0·5mm. to 0·7mm. in breadth.

The œsophagus is 0·18mm. long by 0·15mm. broad and the œsophageal bulb is 0·25mm. long by 0·2mm. broad so that it is just over half as long as that of the female.

The posterior end of the male for a distance of 0·6mm. is surrounded by a large bursa. This is supported by three pairs of papillæ. The most anterior pair is large and is situated from 0·25mm. to 0·27mm. from the posterior extremity. The papillæ of the other two pairs arise close together at the sides of the tail point. One pair of ventral papillæ are present at the sides of the cloaca.

The tail ends in a short blunt point.

The centre of the sucker is about 0·25mm. from the posterior end. This sucker is quite large with a diameter of 200μ, and is incompletely annular in shape. Its walls are striated, and at one level the striæ are broken which gives the sucker an appearance like that of two horseshoes, placed one inside the other. The gap in the walls is situated caudad. In the central gap of the sucker lie two teeth, symmetrically placed at each side with their points directed posteriorly. At the sides of the gap in the sucker wall are two pointed flaps of transparent cuticle which

reach to the cloaca which is about 50μ caudad of the sucker. The cloaca is two lipped.

The single spicule is about 340μ long and 15μ wide. Its proximal end is knob-like.

A gubernaculum is present. In lateral view it is shaped like a long arrow head.

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NOTES ON THE INCIDENCE OF FILARIAL INFECTION IN THE NEIGHBOURHOOD OF LAMU, BRITISH EAST AFRICA.

By G. DUNDERDALE, M.D., M.R.C.S.

Introductory Remarks.—On proceeding from Nairobi to assume medical charge of the station of Lamu, I was asked by the Principal Medical Officer to investigate, if possible, the subject of filariasis and elephantiasis in the neighbourhood, with special reference to the marked difference in percentage infections reported by previous Medical Officers from two villages only a few miles apart.

In his Annual Report for the year 1911-1912 the Medical Officer in charge gave the following table :—

Cases examined	118
No. showing filarial infection	42
Percentage infected	35·60
These cases were from the following sources :—	
Cases from Lamu itself	67
No. infected	27
Percentage infected	40·30
Cases from Siyu	28
No. infected	14
Percentage infected	50·00
Cases from Faza	23
No. infected	1
Percentage infected	4·34

Particular attention was invited to the striking difference in percentage between the two places, Faza and Siyu, which are situated on the same island, and only a few miles apart. Apparently, however, no work had been done on the question of tribal incidence, and I could find no record of the identification of any particular filaria.

I therefore decided to attempt to work out, as far as possible, the following points:—

1. Percentage of persons infected.
2. Percentage according to locality.
3. Tribal incidence.
4. Causative filaria.
5. Carrier or other predisposing agent.
6. Relation between filariasis and elephantiasis.

This programme proved much too extensive for completion in the time at my disposal, and the work was handicapped by difficulties in securing clinical material (a large amount of the work having to be done after 8 o'clock p.m.), and by the lack of equipment for research at this station.

The locality provides an ample and compact field for study, and further accurate observations would be of great interest and value. But it is very desirable that the observer should have his whole time free for his research for some months at a time.

Elephantiasis and filariasis appear to exist all along the coast of British East Africa, with the exception of the most northerly portion.

From the Tana River (40 miles south of Lamu) up to Kiunga (about 50 miles north of Lamu) these conditions are to be found, but the localities where they are most common are undoubtedly the islands of Lamu and Patta, and certain areas on the Tana River. On the mainland, except for the Tana River area, the diseases under consideration are far less common, and occur in the majority of cases among island natives who have settled on the mainland.

Cases also occur further south, and some of those examined and dealt with in this paper appear to have contracted their infection at Mombasa and other places in British and German East Africa. In an addendum a few cases from Pemba are dealt with at the end of this paper.

Clinical Appearances.—The common obvious form of the disease elephantiasis is that affecting the legs, known locally as "madende"; scrotal elephantiasis also occurs commonly.

I have seen no other forms of this disease, though some cases of lymphangitis closely resemble it, and may be seen affecting the arms. I class these not as elephantoid lesions proper, but as filarial. Of the latter many are to be seen. Filarial fever is frequent, and lymphangitis and hydrocele common. Lymphangiectasis occurs. I have seen no definite cases of chyluria.

Apart from such manifestations, however, it must be admitted that the majority of persons who harbour filariæ in their systems present no clinical lesions at all, at least for a large period of their lifetime. Though filariasis occurs, as stated, all along the coast of East Africa, the region round Lamu appears to be a real endemic area, and a note on its climate and physical features, etc., will not be out of place.

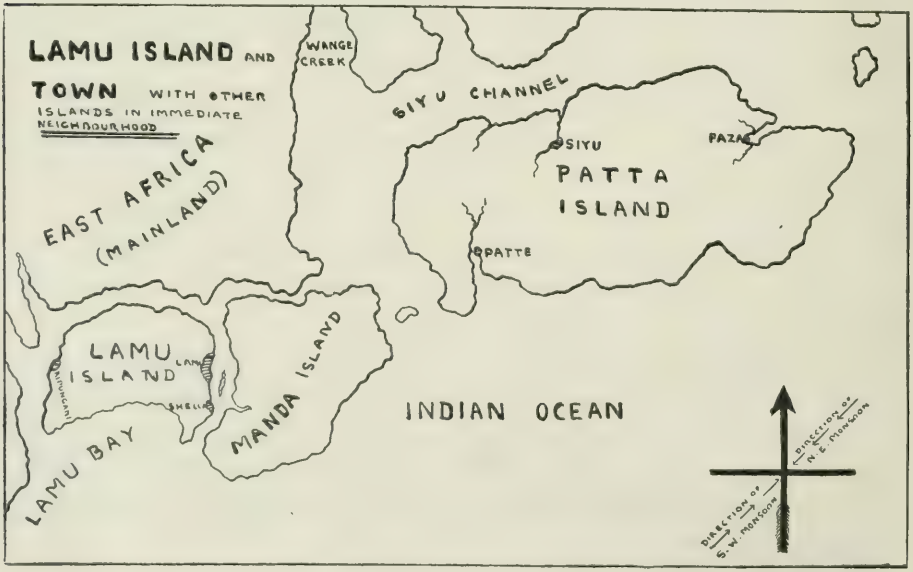
The island of Lamu is situated about two degrees south of the Equator. It is close to the mainland, lying in a small bay, and is separated on its northern and eastern aspects from the Indian Ocean by the island of Manda, which screens a large portion of it from the open sea, and provides it with a sheltered harbour.

The island of Patta lies a few miles to the north-east of Manda, and is rather larger, and fully exposed to the sea on its eastern aspect.

Both islands were much more prosperous in former times than they are now, having been occupied by the Arabs and the Portuguese, and seen considerable trade and activity in the past.

The population is, accordingly, very mixed, and in addition to almost every tribe of East and Central African native there may been found Indians, Egyptians, and Persians, or their descendants. The question of tribal incidence has therefore considerable interest.

A sketch map of the immediate neighbourhood is included to illustrate certain points in this paper.



Most of this endemic area is flat, with a little rising ground, and some sand hills. The soil is sandy. Nearly the whole of the island of Lamu is cultivated with coconut trees, which are also cultivated largely at Siyu Faza. Mangrove bushes and trees are also plentiful. The climate is healthy and fairly dry. In Lamu, where regular records are taken, the rainfall for the whole year was 34·90 inches in 1914, and 42·51 inches in 1915. It may be considered to average about 37 inches for the year, and is usually rather more on the mainland.

In 1914 the average shade temperatures for the year in Lamu, were: maximum 87·62°, minimum 78·59°, and in 1915 the corresponding figures were 85·08° and 76·56° respectively. The fresh winds prevent any marked sense of heat in the daytime, and the nights are rarely oppressive.

It is stated that two atmospheric conditions, viz., high air temperature and considerable atmospheric humidity, are generally associated with the prevalence of filariasis and elephantiasis. I have no means of measuring the relative humidity in this locality, but the temperature cannot be considered very high for the Tropics. Lamu itself has a sandy foreshore facing east, while Siyu, to which further reference will be made, is situated on a sluggish creek, surrounded by mangrove bushes, and the relative humidity there is probably high. This creek faces west, and is not well ventilated in either monsoon.

The population of the principal towns and villages of the locality is as follows (approximately) :—

Lamu Island	7,000
Faza	2,990
Siyu and Patta	2,000
Mkonumbi (mainland) ...	900
Witu (mainland)	850
Kipini (Tana River)	600

The people are largely occupied in agriculture, or as sailors and fishermen. They show a wide variation, from comparative civilisation to gross ignorance and superstition, and are, on the whole, extremely primitive in their attitude towards medicine and research work. Operative treatment is almost always refused, and post-mortem examinations are hardly ever performed owing to the abhorrence with which they are regarded by the majority of persons of the Mohammedan faith. Operative measures for the improvement or cure of elephantiasis are

therefore out of the question at present, and it is impossible to avail oneself of the large amount of material for investigating the pathology and morbid anatomy of the lesions grouped under the heading of elephantiasis.

The chief diet of Arabs, Indians, and Africans is rice, but the latter also eat a fair quantity of Indian corn and other cereals. Meat and fish are eaten in Lamu, the latter being very plentiful and cheap,

Elephantiasis is unrecorded among Europeans here, and is uncommon among Indians.

Sanitation in all the areas is bad, and all water supply either contaminated with sewage, or brackish and saline, except in the Tana River district.

Entomology.—Ticks, fleas and lice are not very common in Lamu. Bugs abound in native mattresses and bedsteads.

Mosquitoes.—The following are universal in the district :—*Culex fatigans, Stegomyia fasciata* and *Pyretophorus costalis*, and at Siyu there is an exceedingly common mosquito, which has been identified as *Howardina pembœnsis*, THEOBALD. *C. fatigans* and *P. costalis* we know are capable of carrying the filarial infection, but I have been unable to obtain personal proof on this point, owing to lack of time and apparatus. Further work remains to be done on the subject.

Causative Filariæ.—Embryonic *Filaria bancrofti* were found in the peripheral blood of all cases returned as infected. Dr. G. C. Low, to whom I submitted specimens, kindly confirmed this for me. All cases were examined after 8 p.m., and many by day as well. In those examined by day, either no filariæ at all were seen, or, at most, one or two to a film. These were exactly the same as those seen in the blood at night. Thick blood-films were taken in the usual way, dehæmoglobinised, and stained with Leishman's stain. This was used not for preference, but because it was always at hand, and I had difficulty in obtaining other stains. Mounted preparations, however, were found to fade very rapidly.

With regard to the relation between filariasis and elephantiasis, I have so far obtained no data of value.

Up to date, 317 cases have been examined in all, and of these 112 show infection with *Filaria bancrofti*. This is a total percentage of 35·33. They may be tabulated as follows :—

Total Cases.	Males infected.	Females infected.	Total infected.		Males free.	Females free.	Total free.
317	97	15	112	...	188	17	205.

Very few females were examined in proportion to the number of males, and the figures are hardly enough to judge by, but it will be seen that of these few a higher percentage is affected than of the males. Elephantiasis of the legs is very commonly observed in elderly women.

TRIBAL TABLE.

Tribe.	No. examined.	No. infected.	Percentage.
Swahili ...	56	22	51·78
Bajun ...	85	31	36·47
Wa Pokomo	86	20	23·25
Arab ...	43	19	44·18
Kikuyu ...	10	1	10·00
Other tribes... (including 17 different tribes)	37	12	32·43

PERCENTAGE ACCORDING TO LOCALITY.

Place.	No. examined.	No. infected.	Percentage.
Tana River ...	89	20	22·84
Lamu ...	66	32	48·48
Siyu ...	82	36	43·90
Faza ...	27	10	37·04
Other places...	53	14	26·41
(Pemba ... (*Vide* Addendum.)	50	20	40·00)

It is, therefore, evident that in this locality the Swahilis, Bajuns and Arabs are the most generally infected with filariasis, and that Lamu and Siyu are the most heavily infected places. Of other tribes, however, with the exception of the Wapokomo, so few have been examined in comparison that the figures with regard to them are of no value. The proper Coast people, *i.e.*, the three tribes mentioned above, should naturally show a heavier percentage of infection than up-country tribes, who are not permanently resident in an endemic area.

The difference in infection at Faza and Siyu respectively is small in my cases, and contrasts markedly with the figures in the table given in the report for 1911, when the percentage infection at Faza was found to be 4·34. It is hardly possible that so great an increase can have taken place in such a short time. In any case more people must be examined from Faza and Siyu. Natural conditions favour a heavy

infection at the latter place. If the map be consulted it will be seen that it faces almost due north-west, and is on the western aspect of the island of Patta. It is low-lying, insanitary, and full of mosquitoes. In neither monsoon does it receive nearly as much direct wind as Lamu, Faza, or Patta, all of which face more or less east, and the people are mostly cultivators, who do not travel about as much as the inhabitants of the busier trading places. Accordingly I attribute the prevalence of the diseases at Siyu to physical and local conditions as much as anything. Lamu Island, which actually shows the heaviest infection of all, has a more mixed and moving population. If all inhabitants—Europeans, Indians and natives—were included in the statistics, the total percentage infection would be considerably lower.

With regard to sexes, it is unfortunate that so few women can be examined, as the percentage among the small number seen appears to be high, and more cases would be of interest. The women, as a rule lead a more sedentary life than the men, and the infection seems to be commoner among persons of sedentary habits than those engaged in active pursuits.

The following table gives the occupations followed by the infected people of this series :—

Cultivator	45
Shopkeeper (including tailors, shoe makers, craftsmen, etc) ...	16
Housework	14
Boatmen and fishermen ...	14
Porter	5
Trader	4
Matmaker	4
Clerk	3
Other work	7

In concluding this paper I wish to express my thanks to Dr. G. C. Low, of the London School of Tropical Medicine, and to Dr. P. H. Ross, Government Bacteriologist, East Africa Protectorate, for valuable assistance and advice in the identification of the specimens of embryonic filariæ, and to Colonel A. Alcock, I.M.S., for kindly identifying specimens of mosquitoes for me.

Addendum.—At a later date I was able to examine a series of cases in the Island of Pemba.

The people of Pemba are more primitive and conservative than any I met on the mainland.

The climate of the island is humid and unhealthy, and all forms of helminthic disease are very common.

Fifty specimens of blood were examined, all from natives of the island, and of these twenty showed infection with *Filaria bancrofti.* Some of these cases showed particularly large numbers of microfilariæ in the circulation.

A number of the patients were infected with ankylostomiasis as well, this disease being exceedingly prevalent in Pemba and Zanzibar.

The total of cases examined in Pemba and on the mainland amounts, therefore, to 367, with 132 showing filarial infection, or 35·96 per cent., a figure which agrees very closely with that found for the Lamu area In both areas the percentages of elephantiasis cases, roughly estimated, similarly correspond.

I have to acknowledge with thanks the permission of the Secretary of State for the Colonies to publish this work, which was done while in the public service.

A CASE OF BILHARZIASIS CURED BY TARTAR EMETIC ADMINISTERED INTRAVENOUSLY,

BY

L. C. D. HERMITTE, M.B., CH.B. (Edin.).

The following case of endemic hæmaturia has been cured by the intravenous administration of tartar emetic, in general practice, and is published in support of the excellent work done by CHRISTOPHERSON in Egypt and CAWSTON in South Africa.

The course of treatment followed here is different from those used by either of these workers, but approaches that of CAWSTON's. It was arranged on the recommendation of Colonel MARSHALL, Lecturer in Tropical Diseases in Edinburgh University, whose advice I took before CAWSTON's article was published in the *Lancet* (17th April, 1920).

In CAWSTON's experience an average total of 12 grains is generally sufficient to effect a cure of the disease. In the present case 13½ grains were necessary before fresh eggs ceased to appear in the urine.

The course was as follows :—

	Half grain	every 2nd day	for 3	doses.
Then	One grain	„	„ 4	„
	Two grains	„	„ 4	„

The urine was centrifugalised and examined daily so that the progress of treatment was closely and carefully watched. Slides were prepared from the outset, and a collection preserved for a final comparison. It has been most interesting to follow the gradual transformation of the

ova, and their gradual disappearance from the urine. Before and during the early days of the treatment, they were elliptical, pale yellowish in colour, possessed a fine transparent shell with a minute sharp thorn-like spike at the posterior extremity, and hatched easily in water. As the treatment progressed the ova gradually became shrunken, shrivelled, blackish in colour with their contents granular, and could not be made to hatch, however long they were left in water. The injections were stopped immediately fresh eggs ceased to appear in the urine. Blackened ova kept appearing after the cessation of the injections, at first fairly numerous, but gradually becoming fewer, until on the eighteenth day after the last injection no ova appeared in the urine.

The examination of the urine was continned from time to time, until two months had elapsed since the last injection, and no more ova were found.

Along with the bilharzial infection the patient had a severe complicating cystitis with much pus and *B. coli* in the urine. On the recommendation of Colonel MARSHALL, washing out of the bladder was avoided. It was treated by hexamine both during the tartar emetic treatment and after. The cystitis cleared up after two months' internal administration of hexamine. The urine is now clear and normal, and all the other symptoms have disappeared. I think we may look upon the patient as cured.

During the treatment there were practically no complications, except headache, and this was easily combatted by the routine administration of aspirin, of which 10 grains were given two hours after each injection and 10 grains at bed-time when necessary. There was no call for the use of codeine, as recommended by CAWSTON, although towards the end of the treatment, when two grains were being administered, the patient complained of a little nausea and tightness of the chest. This was relieved by aspirin. Within half an hour of the 2-grain injections the patient had bouts of coughing which lasted on an average fifteen minutes.

History of the case.—The patient, G. N., was sent to Egypt with the 1st Welsh Horse, in January, 1916. He had no illness before he went out.

In February, 1917, after having been in Egypt over a year, he noticed

that he had pain on micturition, and that his urine contained a large amount of thick blood.

He was transferred from Egypt on May 1st, 1918, to France, where he was admitted to hospital at Abbeville. There his urine was examined and for the first time his condition was diagnosed as bilharzial disease. He was admitted to hospital at Dewsbury, where he remained without treatment until the 25th August, 1918, when he was discharged.

He was admittted to the Burton-on-the-Water Cottage Hospital on April 17th, 1920, when a large number of pale yellow thin shelled ova, with terminal spikes were found in the urine.

The ova hatched easily after a few minutes in water; the hatching occurred more rapidly when warm water was used.

RECORD OF TREATMENT OF INTRAVENOUS INJECTIONS OF TARTAR EMETIC.

Besides other Treatments mentioned below the Patient on the outset was put on Hexamine, gr. X., t.d.s. Diet ordinary throughout

		The Urine (Second 24-hour Specimens).							
Date.	Antimony Tartarate	Reaction.	Deposit.	Blood.	Pus Cells.	Epithelial Cells.	Bacteria.	Crystals.	Ova.
April 21	Gr. ½ at 5 p.m.	Acid	Copious Pus, Blood Clots	+	+ +	—	B. Coli +	Few. Calcium Oxalate	Copious, all normal and easily hatched.
,, 22	—								
,, 23	Gr. ½ at 4 p.m.	Faintly Acid	Copious Pus	+	+ +	+	B. Coli + + +	Stellar Phosphate	Ditto.
,, 24	—								
,, 25	Gr. ½ at 2.45 p.m.	Ditto	Copious Pus	+	+ +	+	B. Coli + + +	Oxalates, Urates	Ditto.
,, 26	—								
,, 27	Gr. 1 at 2.30 p.m.	Ditto	Copious Pus, Crystals	—	+	—	B. Coli +	Stellar Phosphates	Ditto.
,, 28	—								
,, 29	Gr. 1 at 2.15 p.m.	Acid	Less Pus	—	+	+	B. Coli +	Triple Phosphate Oxalate	Copious, normal hatch after long standing in water.
,, 30	—								
May 1	Gr. 1 at 3.30 p.m.	Ditto	Less Pus, Phosphates	—	+	+	—	Stellar Phosphate	Copious, normal, one or two granular in appearance.
,, 2	—								
,, 3	Gr. 1 at 2.30 p.m.	Ditto	Less, Little Pus, Phosphates	—	+	+	+	Triple Phosphate and Urate	Very few normal. Ova all pale yellow.
,, 4	—								
,, 5	Gr. 2 at 5.30 p.m.	Ditto	Less Phosphates	—	+	+	+	Triple Phosphates	Most Ova still pale in colour, but more granular; a few much darker.
,, 6	—								
,, 7	Gr. 2 at 3 p.m.	Ditto	Scanty, Little Mucus	—	Very Few	+	+	Ca. Oxalate (large amt.)	Few Ova, pale granular; one or two darker.
,, 8	—								
,, 9	Gr. 2 at 5 p.m.	Ditto	Scanty	—	Very Few	+	+	Ca. Oxalate, Few Triple Phosphates	Mostly granular, darker and shrivelled.
,, 10	—								
,, 11	Gr. 2 at 4 p.m.	Ditto	Much Less	—	More	+	+	Ca. Oxalate	All granular and shrivelled. Fairly numerous.
,, 12	—								
,, 13	—	—	—	—	—	—	—	—	All Ova shrivelled, granular and black.

Obituary.

SIR JOHN KIRK, G.C.M.G., K.C.B., M.D., F.R.S.

Honorary Fellow of the Royal Society of Tropical Medicine and Hygiene, 1914–1922.

Sir John Kirk, whose death at Sevenoaks was announced on 15th January, 1922, at the age of 89 years, was an Honorary Fellow of the Society. His life takes us back to the days of Livingstone, whose chief colleague he was in the Zambesi expedition of 1858. Kirk was a son of the manse, born at Barry, Forfarshire, N.B., and as a boy was interested in botany and natural history generally.

After graduating at Edinburgh in 1854, he gained experience as a leader of a voluntary party of medical men who went out to the Dardanelles during the Crimean War, where he was assistant physician at a base hospital. Doubtless, he gained a knowledge of tropical disease in that campaign, and in 1858 he was attached to Livingstone's Zambesi party, primarily as a naturalist. He did valuable work as an explorer and scientist during five years, and was then appointed as Medical Officer at Zanzibar in 1866. It was, however, as an administrator that he did his best work, and he was first Assistant Consul, then Consul-General and Resident at Zanzibar, where he rendered yeoman service in upholding his country's interests, and in safeguarding the destinies of that great land.

Decorations and honours were showered upon him in recognition of his scientific and administrative powers. These included a K.C.M.G. in 1881, G.C.M.G. in 1886, and K.C.B. in 1890. In 1882 he received the Patron's Medal of the Geographical Society, of which for many years he was Foreign Secretary. He was an Hon. LL.D. (Edin.), D.Sc. (Cantab.), and D.C.L. (Oxon.), and was F.R.S. and F.L.S.

He took a prominent share in the opening up of East Africa; a worthy pioneer in whose steps a distinguished band of medical workers have followed, to Africa's lasting benefit. C. F. H.

LIST OF FELLOWS.

The following have been duly elected Fellows of the Society:—

John Cotter Baker, M.B., B.Ch. (Dublin), L.M. (Rot.), India.

Dhirendranath Basu, M.B. (Cal.), Hampstead and India.

Sampson Charles Jenkin Bennett, B.Sc., M.R.C.V.S., India.

Abdul Hamid Butt, M.B., B.S. (Lahore), Kensington and India.

Capt. Andrew Robert Fausset Clarke, M.C., M.B., Ch.B. (Edin.), R.A.M.C., Sudan.

James Kilian Clarke, M.B., B.Ch., D.P.H., D.T.M. & H., Cairo.

George Naguib Cossery, Diploma in Medicine and Surgery (Cairo), Highgate and Public Health Laboratories, Cairo.

Benjamin Harold Day, M.D., F.R.C.P., Professor of Medicine, School of Medicine, Cairo.

James Douglas Dimock, M.R.C.S. (Eng.), L.R.C.P. (Lond.), L.D.S., R.C.S. (Eng.), West Africa.

Rajinder Singh Grewal, L.M.S., L.M.P., Assistant Surgeon, General Hospital, Meiktila, Burmah.

Patrick Howard Hennessy, M.B. (Madras), M.R.C.S., L.R.C.P., Federated Malay States.

Eric Perrin Hicks, B.A., M.B., M.R.C.S., L.R.C.P., Temple, E.C.

Arthur Stanley Hirst, F.L.S., Assistant Keeper, Natural History Museum, South Kensington.

Albert Launcelot Hoops, M.D., M.B., B.Ch., B.O.A., D.P.H. (Trinity College, Dublin), L.M. (Rot.), Singapore.

Henry Epton Hornby, O.B.E., F.R.C.V.S., D.V.S.M., Tanganyika.

Capt. Cecil John Rhodes Lawrence, O.B.E., M.R.C.V.S., R.A.V.S., Aldershot.

Edmund Lloyd, M.B., B.Ch. (Cantab.), Sudan.

Courtenay Henry Gerard Pochin, F.R.C.S. (Edin.), M.R.C.S. (Eng.), L.R.C.P. (Lond.), Egypt.

Capt. Basil Hamilton Hebden Spence, M.B. (Edin.), R.A.M.C., Sudan.

MOVEMENTS OF FELLOWS.

The following Fellows have notified the Secretaries that they are at present in England:—

Major C. H. Bowle-Evans, C.M.G., India.
F. Charlesworth, M.D.
H. F. Conyngham, L.R.C.P., Borneo.
Major F. W. Cragg, M.D., I.M.S., India.
J. B. Davey, M.B., M.R.C.S., Tanganyika.
H. Lyndhurst Duke, B.A., B.C., M.D., Uganda.
Colonel F. W. King, F.R.C.S., India.
J. Scott Macfie, M.B., Gold Coast.
P. A. Maplestone, D.S.O., Australia.
F. W. O'Connor, M.R.C.S.
W. H. Peacock, M.B., M.R.C.S., Sierra Leone.
A. Pearson, M.B.
Arthur Pickels, M.B., B.S., Gold Coast.
J. Macfarlane Pollard, M.B., Nigeria.
A. T. Stanton, M.D., Malay States.

H. S. Hollenbeck, M.D., Angola, is at present in U.S.A.

EDITORIAL NOTICE.

Complete sets of the first four volumes of the Transactions belonging to the Society have now become very scarce. If any Fellows possess these volumes, or any odd numbers of the same, and no longer require them, the Council would be greatly obliged if they could be presented to the Society.

There are frequent applications for these volumes from Libraries which are desirous of completing their sets. At the present time it is impossible to meet these requests, and it is felt that it would be doing a service to the cause of science to help them as far as possible.

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The Editor of the TRANSACTIONS will be pleased to receive short papers to be included under the heading of "Notes and Comments" or "Questions," in addition to longer papers on subjects of Tropical interest, which may be offered for presentation at meetings of the Society. He will also be glad to receive books for review.

Attention is drawn to the rule that Contributors of papers to the TRANSACTIONS receive 25 reprints free of charge, *provided they apply for these when sending the paper.*

Any communication for the Editor should be addressed to THE EDITOR of the TRANSACTIONS of the Royal Society of Tropical Medicine and Hygiene, 11, Chandos Street, Cavendish Square, W. 1.

THE PRACTICE OF MEDICINE IN THE TROPICS

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